

# ForeRunner ASN-9000 ATM Software Reference Manual

MANU0273-01 Rev A - November 7, 1997

Software Version ASN\_FT 4.0.0

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# **Preface**

This manual describes the *ForeRunner* ATM Services Node 9000 (ASN-9000) Asynchronous Transfer Mode (ATM) command subsystems. For information on Boot PROM commands, refer to *ForeRunner ASN-9000 Hardware Reference Manual*. For information on other command subsystems, refer to *ForeRunner ASN-9000 Software Reference Manual*. For information on applying and configuring filters, refer to *ForeRunner ASN-9000 Filters Reference Manual*.

# **Chapter Summaries**

**Chapter 1 ATM Commands** - Describes commands for configuring and managing the *Fore-Runner* ASN-9000 switch as an ATM router.

**Chapter 2 - RFC-1483 Bridge Encapsulation over PVC** - Describes commands for connecting the *ForeRunner* ASN-9000 switch to an ATM backbone.

**Chapter 3 - Routed 1483 over ATM** - Describes commands for connecting the *ForeRunner* ASN-9000 switch as a routed backbone.

**Chapter 4 - LANE LEC Configuration** - Describes commands for overlaying your Ethernet LANs on top of an ATM network.

**Chapter 5 - FORE IP** - Describes commands for using FOREIP to emulate basic characteristics of an IP network.

**Chapter 6 - Classical IP over ATM** - Describes commands for using CLIP to transmit IP datagrams and ARP (Address Resolution Protocol) requests and replies over ATM using AAL5.

**Chapter 7 Classical IP PVC over ATM** - Describes commands for using CLIP to transmit IP datagrams and ARP (Address Resolution Protocol) through the ATM backbone.

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#### support@fore.com

2. You may FAX your questions to "support" at:

#### 412-742-7900

3. You may send questions, via U.S. Mail, to:

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4. You may telephone your questions to "support" at:

#### 800-671-FORE or 412-635-3700

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# **Typographical Styles**

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the Enter or Return key is represented as <ENTER>. The following example demonstrates this convention:

#### cd /usr <ENTER>

File names that appear within the text of this manual are represented in the following style: "...the fore\_install program installs this distribution."

Command names that appear within the text of this manual are represented in the following style: "...using the flush-cache command clears the bridge cache."

Subsystem names that appear within the text of this manual are represented in the following style: "...to access the bridge subsystem..."

Parameter names that appear within the text of this manual are represented in the following style: "...using <seg-list> allows you to specify the segments for which you want to display the specified bridge statistics."

Any messages that appear on the screen during software installation and network interface administration are shown in Courier font to distinguish them from the rest of the text as follows:

.... Are all four conditions true?

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To call your attention to safety and otherwise important information that must be reviewed to ensure correct and complete installation, as well as to avoid damage to the FORE Systems product or to your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

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#### CAUTION



You risk damaging your equipment and/or software if you do not follow these instructions.

**NOTE** statements contain information that has been found important enough to be called to the special attention of the operator and is set off from the text as follows:



If you change the value of the LECS control parameters while the LECS process is running, the new values do not take effect until the LECS process is stopped, and then restarted.

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Class 1 Laser Product: This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

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The Laser Notice section applies only to products or components containing Class 1 lasers.

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- Never push objects of any kind through openings in the equipment. Dangerous
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#### **WARNING!**



Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

### Preface

# CHAPTER 1

# **ATM Commands**

This chapter describes the commands found in the atm subsystem. These commands let you configure and manage the ASN-9000 as an edge device for ATM. Refer to the *ForeRunner ASN-9000 Software Reference Manual* for all other software commands. Refer to the specific chapter for configuring a PowerCell segment to use a specific ATM protocol, see the appropriate chapter:

- To configure parameters for RFC-1483 Encapsulation over PVC, see Chapter 2, RFC-1483 Bridge Encapsulation over PVC.
- To configure parameters for Routed 1483 over PVC, see Chapter 3, Routed 1483 over ATM.
- To configure LANE 1.0 parameters, see *Chapter 4, LANE LEC Configuration*.
- To configure FORE IP parameters, see *Chapter 5, FORE IP*.
- To configure CL IP parameters, see Chapter 6.
- To configure CL IP PVC parameters, see Chapter 7, Classical IP PVC over ATM.

# 1.1 Accessing the ATM Subsystem

To access the atm subsystem, issue the following command at the runtime prompt:

atm

# 1.1.1 ATM Port (PHY) Selection Commands

The commands in this section enable the selection and display of information about the primary and backup port (PHY) on the ASN-9000 PowerCell. (See Section 1.1.1.)

# 1.1.1.1 Selecting a Port

The PowerCell uses the primary port by default. If the link to the primary port fails, the backup port automatically takes over, provided a redundant link has been established to the port switch. Also, if using the backup port and it fails, the software switches back to the primary port.

After correcting the problem that led to the link failure on the primary port, it is necessary to manually change back to the primary port to use it again. The active-ama|aa command allows manual switching between the backup port and the primary port.



When changing from one port to the other, the connection to the ATM switch (and therefore the ATM network) is temporarily lost while the software switches the connections to the new port.

The syntax for the active-ama | aa cset command is:

active-ama|aa cset p[rimary]|b[ackup] <slot>|all

**<slot>** Specifies the slot containing the PowerCell module.

Slots are labeled on the chassis edge. The slot number can also be determined by issuing the

system config show command.

primary|p|backup|b Selects the port to use. If primary is specified, the port labeled PRIMARY is used. If backup is specified, the port labeled BACKUP is used. The

default is primary.

NOTE

If the PowerCell module contains a backup port but the backup port is down, the software attempts to switch to the backup port, recognizes that the port is not available, then immediately switches back to the primary port. Connection to the ATM switch is temporarily lost, then reestablished.

Here is an example of this command:

117:ASN-9000:atm# aa cset p 2

This command selects the primary port. To save the port selection, save the configuration using the system savecfg or tftp savecfg command.

<sup>&</sup>lt;sup>1.</sup> The port-selection commands contain the word "ama" in reference to the AMA (ATM Media Adapter) on the PowerCell. Each ATM port on the PowerCell is provided by an AMA.

### 1.1.1.2 Verifying the ATM Port Selection

Use the active-ama | aa show command to indicate the port that has been selected for use and the port that actually is in use. The syntax for this command:

active-ama aa [show] [linemode | lm] <slot> all

show Displays the linemode configured for the ATM

Media Adapter (AMA).

linemode|Im Allows you to specify that a linemode is to be

configured.

<slot>|all Displays the specific slot you have configured.

Slots are labeled on the chassis. The slot number can also be determined by using the system

config show command.

In the following example, the primary port is both selected and in use.

1:ASN-9000:atm# aa show 4

AMA Configurations for Slot 4:

Primary Backup (Installed)

User Selected AMA : PRIMARY Actual In Use AMA : PRIMARY

PHY UTOPIA Level : 1 1
PHY UTOPIA Version: 2 2
PHY Protocol Type : 155M 003

PHY Protocol Type : 155M OC3 155M OC3
PHY Media Type : Multimode Fiber Multimode Fiber

The fields in this display show the following information:

User Selected AMA The port specified for normal operation. Unless explicitly changing port assignments, the primary

port is used by default and the backup port only if

the link to the primary port fails.

**Actual In Use AMA** The port that is actually being used. If the link to the

primary port fails, this field shows that the backup port is in use, even though the primary port was

selected for use.

PHY UTOPIA Level The PHY UTOPIA level in use by the PowerCell

module and port. UTOPIA is an ATM standard for the communication between the PowerCell module

and the PHY (port).

PHY UTOPIA Version The version of the PHY UTOPIA in use by the

PowerCell module and the port.

**PHY Protocol Type** The PHY-layer protocol in use on the port. The

protocol must be the following:

155M OC3155 Mb/s using an OC-3 connector.

PHY Media Type The type of cable connecting the port to the ATM

switch. The cable type can be one of the following:

Single Mode Fiber Multimode Fiber CAT5 UTP

Normally, the primary port is selected by the software and used for ATM traffic between the PowerCell module and the ATM switch. However, if the primary link fails or you explicitly select the backup port, the PowerCell uses the backup port. The aa show command shows that the backup port is in use as follows:

```
2:ASN-9000:atm# aa show 4
AMA Configurations for Slot 4:
```

Primary Backup (Installed)

User Selected AMA : PRIMARY

Actual In Use AMA:

PHY UTOPIA Level: 1

PHY UTOPIA Version: 2

PHY Protocol Type: 155M OC3

PHY Media Type: Multimode Fiber

Multimode Fiber

Notice that the Actual In Use AMA field lists the backup port in use, even though the primary port is selected. To use the primary port again, correct the problem that caused the primary link to fail, then use the aa cset command to select the primary port. (See Section 1.1.1.)

# 1.1.1.3 Setting the Backup Linktimer

Set a default linktimer value if the link to the primary port fails. Before the backup port automatically takes over with primary port failure, the ASN-9000 waits for a time period to determine whether the primary port comes back up, provided the linktimer value has been set with the active-ama acset command. The syntax for the ama cset command is:

active-ama|aa cset linktimer|lt <time\_sec> <slot>|all

linktimer|It Specifies that the default linktimer is being set

with the cset command. The PowerCell waits for the duration of time set in link-down condition before switching to the back-up PHY.

<time\_sec> Specifies the amount of time, in seconds, before

the primary port switches to the backup port. The range of value is between 2.5 to 600

seconds. The default is 2.5 seconds.

**<slot>|all** Specifies the slot containing the PowerCell module.

Sots are labeled on the chassis. Slot number can also be determined by using the  ${\tt system}$ 

config show command.

Here is an example of this command:

117:ASN-9000:atm# aa cset 1t 30 2

# 1.1.1.4 Verifying the Backup Linktimer

Use the active-ama | aa show command to display the linktimer value for backup port switchover. The syntax for this command is:

active-ama a [show] [linktimer | lt] <slot> all

**show** Displays the linemode configured for the ATM

adapter.

linktimer|It Specifies the default linktimer with the cset

command. The PowerCell waits for the duration of time set in link-down condition

before switching to the back-up PHY.

<slot>|all Displays the specific slot you have configured.

Slots are labeled on the chassis. Slot numbers can also be determined by using the system

config show command.

Here is an example of the display produced by this command. In this example, the primary port is both selected and in use.

1:ASN-9000:atm# aa show lt all Slot 2 linkdown\_timer 30 2:ASN-9000:atm#

### 1.1.1.5 Displaying and Clearing Statistics

To display statistics for the active AMA selected port, use the **stats** show command. The syntax for this command is:

stats [show] active-ama|aa <slot>|all

**active-ama**|aa Displays the active AMAs on the slot.

**<slot>|all** Displays the specific slot configured for AMAs.

Here is an example of the display produced by this command. In this example, **all** is selected and in use.

1:ASN-9000:atm# stats show aa all PHY Type: OC3 Slot: 1 Multi-errored cell: 0 Path RDI soak: 669 B1 block error: 0 B2 block error: 0 B3 block error: 0 B1 coding violation: B2 coding violation: 0 B3 coding violation:

The fields in this display show the following information:

**PHY Type** The type of the PHY in use by the PowerCell module

and the port.

**Slot** The port that is actually being used. If the link to the

primary port fails, this field shows that the backup port is in use, even though the primary port was

selected for use.

Multi-errored cell The ATM cells that are received with multiple-bit

errors in the 5-byte ATM header.

**Path RDI soak** The amount of time that a loss-of-cell-alignment

(LOCA) condition must be present before a path RDI

condition is sent via the outgoing G1 byte.

B1/B2/B3 block error Displays the total number of frames received with

B1, B2, and B3 errors.

B1/B2/B3 coding violation Displays the total number of received B1, B2, and B3

bit-interleaved parity (BIP) bits that are in error.

To clear statistics for the active AMA selected port, use the stats clear command. The syntax for this command is:

stats clear active-ama|aa <slot>|all

# 1.1.2 Segment Configuration Commands

The commands in this section are used to configure rate groups and assign an ATM protocol and rate group to each ATM segment.

### 1.1.2.1 Configuring a Rate Group

Rate groups enable the bandwidth to be divided into different groups of usage. Up to 16 different groups can be set by using the rate-group|rg cset command. To configure a rate group for the PowerCell module, issue the following command:

rate-group rg cset <rate-group> <rate> <slot>

<rate-group>

Specifies the rate group. Specify a number from 1 through 16. The default rate group for all segments is 1.

<rate>

Specifies the rate. Specify the rate in Mb/s or Kb/s.

To specify the rate in Kb/s, enter "k" or "k" after the number. For example, to specify 45000 Kb/s, enter the number as 45000k or 45000k.

To specify the rate in Mb/s, enter "m" or "M" after the number. For example, to specify 45 Mb/s, enter the number as 45m or 45m.

If the rate is not indicated is in Kb/s or Mb/s, Mb/s is assumed.

Specify a rate from 1 to 155000 Kb/s for group 1 or a rate from 0 through 155000 Kb/s for groups 2 through 16. The default for rate group 1 is 155000 Kb/s. The default for rate groups 2 through 16 is 0 Kb/s.

When configuring the rate group, specify a bit rate that is equal to or lower than the maximum bit rate supported by the physical interface of the ATM port. For example, if the ATM port is an OC-3 port, the port can transmit at 155000 Kb/s or lower. If a rate group with a higher bit rate is applied to the port, the port still transmits at 155000 Kb/s or less.

The PowerCell software uses rate group 1 for all ATM signalling and ILMI traffic. Therefore, do not configure rate group 1 for 0 Kb/s unless ATM signalling and ILMI traffic is to be eliminated on the PowerCell module.

<slot>

Specifies the slot containing the PowerCell module. Slots are labeled on the chassis. Slots can also be determined by number using the system config show command.



The total for all the rate groups for the PowerCell module must be 155000 Kb/s or less.

Here is an example of the rate-group cset command.

3:ASN-9000:atm# rg cset 4 3 1

### 1.1.2.2 Displaying Rate Groups

To display configuration information about the rate groups configured for the PowerCell module, issue the following command:

rate-group | rg [show] < slot > | all

<slot>|all

Specifies the chassis slot that contains the PowerCell 700. The slots are labeled on the *ForeRunner* ASN-9000 chassis. You also can determine the slot number using the **system config show** command. If you specify **all**, the rate groups are displayed for all the PowerCell modules in the chassis.

Here is an example of the information displayed by this command. In this example, the rate group configuration for the PowerCell module in slot 4 is displayed.

As shown in this example, the Kb/s allocated to each of the 16 rate groups is listed. Following the listings for the individual rate groups, this display lists the total Kb/s allocated among all 16 rate groups and the amount of idle (unallocated) Kb/s, if any.

### 1.1.2.3 Configuring ATM Segments

Up to 32 logical segments can be configured on a PowerCell. For each segment, the protocol and the rate group used by that segment can be specified. Each segment on the PowerCell module can be configured for only one protocol and one rate group.



The segments must already be allocated to the slot that contains the PowerCell module. Allocate segments by using the nvram set slotsegs command.

To configure the protocol and rate group for a segment on the PowerCell module, issue the following command:

#### protocol|proto sset proto <seglist>|all

Specify one of the following:

fore-ip | fip FORE IP.

lane | 1 LANE (LAN Emulation) 1.0.

classical-ip | c Classical IP over ATM (see RFC

1577).

classical-ip-pvc | cp Classical IP PVC over ATM (see

RFC 1577).

routed-1483 | r1483 Routed IP 1483 over ATM (LLC

SNAP encap routed IP) (see RFC

1483).

bridge-encap | b RFC-1483 Encapsulation over

PVC (Ethernet LAN Packets

only).

None | n Removes or disables a protocol

from a segment.

<segment-list>|all

Specifies the PowerCell segment being configured. Specify a single segment number, a commaseparated list of segments, or a hyphen-separated range of segments. If all is specified, all segments on all the PowerCell modules in the chassis are configured to use the ATM protocol and rate group specified.

To configure the rate group for a segment on the PowerCell module, issue the following command:

sset rate-group|rg 1|2|3|4 <segment>|all

1|2|3|4 Associates a segment with a rate group. Specify a rate group number from 1 through 4. The default rate group for all segments is 1.

#### <segment>|all

Specifies the PowerCell segment being configured. Specify a single segment number, a commaseparated list of segments, or a hyphen-separated range of segments. If all is specified, all segments on all PowerCell modules in the chassis are configured to use the ATM protocol and rate group specified.

# 1.1.2.4 Displaying Configuration for ATM Segments

To display configuration information for segments on a PowerCell module, issue the config command. This command displays the protocol and rate group configured on the segment using the config command. (See Section 1.1.2.3.)

config [show] [s[egments]=]<seglist>|slot=<slot#>|all

<seglist>

Specifies the segments. Specify an individual segment number, a comma-separated list of segment numbers, or a hyphen-separated range of segment numbers.

<slot#>

Specifies the slot number.

Here is an example of the information displayed by this command. In this example, the ATM configuration for segment 19 is displayed.

4:ASN-9000:atm# config show 2.4

Segment	Protocol	State	Rate Group
2.4	None	Disabled	1

The fields in this display show the following information:

Displays the segment number(s). Segment

Protocol Lists the ATM protocol assigned to the segment. The

protocol can be one of the following:

fore-ip | fip FORE IP.

lane | l LANE (LAN Emulation) 1.0.

classical-ip | c Classical IP over ATM (see RFC

1577).

classical-ip-pvc | cp Classical IP PVC over ATM (see RFC 1577).

routed-1483 | r1483 Routed IP 1483 over ATM (LLC

SNAP encap routed IP) (see RFC

1483).

bridge-encap | b RFC-1483 Encapsulation over

PVC (Ethernet LAN Packets only for the *ForeRunner* ASN-

9000).

None | n

State

Indicates the state of the ATM protocol. If the protocol is disabled, enable it using the appropriate command:

To enable the FORE IP protocol, use the atm/foreip senable command.

To enable the LANE 1.0 protocol, use the atm/lane lec cenable command.

To enable the CLIP protocol, use the atm/clip senable command.

To enable RFC-1483 Encapsulation, use the atm/1483routed senable command.

Rate-Group

Indicates the rate group assigned to the segment.

### 1.1.2.5 Displaying VCs for Specified ATM Segments

To display the active virtual circuits (VCs) on specified segments, issue the **vc show** command. This command displays the number of VCs configured on the specified segments. The syntax for this command:

vc [show] <seglist>|all

<seqlist>|all

Specifies the segment number of the segment to display information. If all is specified, the information is listed for all active segments.

The following information is displayed:

For each LANE-enabled segment LEC Configuration Direct PP SVC

LEC Control Direct PP SVC

LEC Control Distribute PMP SVC LEC Multicast Send PP SVC

LEC BUS Multicast Forward PMP SVC

LES Control Distribute PMP SVC, if LES is on ATM

card.

All LES Control Direct PP SVCs, if LES is running on

ATM card.

BUS Multicast Forward PMP SVC, if BUS is running

on ATM card.

All LEC Data Direct PP SVCs

For FORE-IP-enabled segments All FOREIP Input and Output SVCs.

For each 1483-Bridge-Encapsulation-enabled segment Input and output 1483 PVCs.

For each CLIP-enabled segment SVC to CLIP ARP Server on same LIS.

All SVCs to remote CLIP clients on same LIS.

Here is an example of the information displayed by the vc show command. In this example, only segment 19 has active VCs and of the 32 segments, only two are configured. Segment 14 has been configured for a protocol, but does not currently have any active VCs. The PVCs that are shown at the bottom of the display are for signalling purposes and should not be removed.

```
31:ASN-9000:atm# vc show all
Total Active VCs on Segment 14: 0
Total Active VCs on Segment 19: 2
Inbound: 300
Outbound: 400
Active Signaling PVCs < 32 on ATM Slot 2: 5 16
Total Active VCs on ATM Slot 2: 4
```

### ATM Commands



# RFC-1483 Bridge Encapsulation over PVC

This chapter describes support for RFC-1483 Encapsulation over PVC (hereafter called RFC-1483 Encapsulation). RFC-1483 Encapsulation provides a simple mechanism for encapsulating MAC layer frames using Permanent Virtual Circuits (PVCs).

Use RFC-1483 Encapsulation if connecting the ASN-9000 to an ATM backbone. RFC-1483 requires fewer configuration steps than LANE 2.0, Classical IP over ATM, and FORE IP.

Note that RFC-1483 Encapsulation does not provide ARP services or broadcast/multicast services. Consequently, if the network is dynamic and requires these services, consider using LANE 2.0, Classical IP, or FORE IP instead of RFC-1483 Encapsulation.

This chapter shows how a PowerCell module configured for RFC-1483 Encapsulation fits into anATM network and describes how to configure a PowerCell segment for RFC-1483 Encapsulation.

# 2.1 The PowerCell Module and RFC-1483 Encapsulation

When configuring a PowerCell segment for RFC-1483 Encapsulation, configure a PVC from one ASN-9000 to another, which traverses the ATM switch. To configure the PVC, assign an incoming and outgoing Virtual Circuit Identifier (VCI) to the segment. VCs are unidirectional.

For each PowerCell segment using RFC-1483 Encapsulation, configure an incoming and outgoing VCI on the ATM switch and on the PowerCell module to which the ATM switch is attached. The incoming VCI on the PowerCell segment must match the outgoing VCI on the ATM switch's port. Likewise, the outgoing VCI on the PowerCell segment must match the incoming VCI on the ATM switch's port.

In this example, VCI 191 is the outgoing VCI on the PowerCell module of ASN-9000 "A", the incoming VCI on one port of ATM switch "C", the outgoing VCI on a different port of ATM switch "C", and an incoming VCI on the PowerCell module of ASN-9000 "B". VCI 192 follows a similar path in the other direction, using the same ports. In the example, one PVC makes each unidirectional connection between the ASN-9000s; the PVC from ASN-9000 "A" to ATM switch "C", and the PVC from ATM switch "C" to ASN-9000 "B" form the first connection, and the second is formed in the other direction.

One RFC-1483 Encapsulation PVC can be configured on each PowerCell segment unless the virtual segment is running another datalink protocol. The PowerCell module supports up to 32 virtual segments, all of which can be allocated to RFC-1483 Encapsulation PVCs if no other datalink protocols are assigned.

# 2.2 Configuring a PowerCell Segment for RFC-1483

To use the PowerCell module for RFC-1483 Encapsulation, the following configuration tasks must be performed:

- Configure RFC-1483 Encapsulation on the segment (senable command).
- Enable RFC-1483 Encapsulation on the segment (senable command).
- Verify the RFC-1483 Encapsulation configuration and operation (config show command).

The following sections describe how to perform these tasks.

# 2.2.1 Configuration Considerations

Before configuring the PowerCell module for RFC-1483 Encapsulation, make sure the configuration plans are not affected by the following considerations:

- The ASN-9000 implementation of RFC-1483 Encapsulation allows connections only using Permanent Virtual Circuits (PVCs). The VCIs for a PowerCell segment must be specified when configuring the segment for RFC-1483 Encapsulation.
- $\bullet$  VC-based multiplexing (described in Section 5 of RFC 1483) is not supported.
- All outgoing packets (packets sent from the PowerCell module to the ATM switch) are sent with the CRC stripped (PID: 0x0007). The ATM switch accepts 0x0001 or 0x0007. The PowerCell sends 0x0007.
- If there are any other protocols configured on the segment, such as FORE IP or LANE, they must first be deleted.

# 2.2.2 Enabling RFC-1483 Encapsulation on a Segment

Before enabling RFC-1483 Encapsulation on a segment, first configure the PowerCell segment using the atm sset protocol command. To configure the PowerCell segment, telnet into or connect to the ASN-9000 through the TTY interface, change to the atm subsystem, and configure the desired segment.



When accessed from within a subsystem, commands do not need to contain the subsystem prefix. Thus, the atm sset protocol command can be used from within the atm subsystem by typing sset protocol. All commands in this manual issued on the ASN-9000 are located in the atm subsystem unless otherwise noted.

17:ASN-9000:atm#sset proto b 1.5

The above command configures segment 1.5 to use PVC Bridging.

After enabling bridge encapsulation on a PowerCell Segment, enable RFC-1483 on the segment. To get to the RFC-1483 Encapsulation subsystem, issue the following command:

#### atm/1483encap

Once in the 1483/encap subsystem, enable RFC-1483 Encapsulation on a PowerCell segment by issuing the following command:

senable <seglist>

**<seglist>** Specifies the PowerCell segment on which RFC-1483 Encapsulation is being enabled.

Following is an example of this command. The command configures ASN-9000 segment 2.2 to enable RFC-1483 Encapsulation on the segment.

10:ASN-9000:atm/1483encap# senable proto b 2.2 Okay

Ise the in-pvc and out-pvc parameters when enabling RFC-1483 Encapsulation on the segment using the senable command. However, only the segment number and state parameters are needed when disabling RFC-1483 Encapsulation on the segment. When a segment is disabled, both incoming and outgoing VCIs are automatically deleted from the segment.

Following is an example of the command to disable RFC-1483 Encapsulation on the segment that was enabled in the previous example.

10:ASN-9000:atm/1483encap# sdisable proto b 2.2 Okay

## 2.2.3 Verifying PowerCell 1483 Encap Configuration

The incoming and outgoing VCIs and packet statistics for a PowerCell segment that is enabled for RFC-1483 Encapsulation can be displayed. To display the RFC-1483 Encapsulation information for a segment, issue the following command:

config [show] <seglist>|all

<segment>|all

Specifies the PowerCell segment(s) for which to display the PVC configuration and statistics. Specify a single segment number or all segments. If all is specified, PVC information is displayed for all the PowerCell segments in the chassis on which RFC-1483 Encapsulation is enabled.

Following is an example of this command. In this example, PVC information is displayed for port 8.

```
12:ASN-9000:atm/1483encap# config show all
RFC-1483 encapsulation information for port 8
In PVC VCI: 182
Out PVC VCI: 25
Total Pkts sent: 25
Total Pkts rcvd: 322
Pkts rcvd with unknown type: 0
Pkts rcvd with unknown protocol: 0
Pkts rcvd with length too big: 0
```

The fields in this display show the following information:

In PVC VCI	The incoming PVC's VCI. Specify this value when
	configuring a PowerCell segment for RFC 1483
	(using the sset inpvc command).

Out PVC VCI The outgoing PVC's VCI. Specify this value when configuring a PowerCell segment for RFC 1483 (using the sset outpvc command).

Total Pkts sent The number of packets sent on this segment's outgoing PVC. The PowerCell module begins accumulating these statistics when RFC-1483

encapsulation on a segment is enabled.

Total Pkts rcvd The number of packets received on this segment's incoming PVC. The PowerCell module begins accumulating these statistics when RFC-1483

encapsulation on a segment is enabled.

Pkts rcvd with unknown type The number of packets received on this segment's

incoming PVC with an unknown type. Any packet that does not contain a SNAP header and an OID of 0080c2 is considered a packet of unknown type.

Pkts rcvd with unknown protocol The PID which is not 0x0001, 0x0007, or 0x000e (STP).

After displaying the RFC-1483 Encapsulation information, do the following to verify that RFC-1483 Encapsulation is operational on the PowerCell module:

- 1. Check the In PVC VCI and Out PVC VCI fields to make sure they contain the VCIs expected.
- 2. Place the segment in a live network (if not already done so), then re-issue the config show command to refresh the display. Check the Total Pkts sent and Total Pkts rcvd fields for signs of activity. If these fields contain zeroes or the other fields indicate errors:
  - a. Reset the ATM module.
  - b. Check the RFC-1483 Encapsulation configuration on the PowerCell module and on the other ATM hardware.
  - Allow the PowerCell module to operate in the ATM network for a few moments.
  - d. Refresh the RFC-1483 Encapsulation display.
  - e. Test the PVC by pinging across the PVC from one end station to another. The commands used to ping depend upon the type of workstation being using as the end station.
  - f. If the PowerCell module and ATM switch are properly configured but the RFC-1483 Encapsulation display still shows no packet activity or shows errors, contact FORE Systems TAC.

## 2.2.4 Removing an RFC-1483 Encapsulation from a Segment

Before using another protocol on a segment configured for RFC-1483 Encapsulation, the current protocol must be disabled and removed from the segment. If this is not done, the segment is not available to run any other protocol.

To disable the segment, issue the **sdisable** command. Following is an example of the command. In this example, the terse form of the command is used.

10:ASN-9000:atm/1483encap# sdisable 2.2 Okay

In the above example, RFC-1483 Encapsulation was disabled on segment 2.2. To verify that the command was successful, issue the **config show** command for that segment.

After disabling the segment, use the atm sset protocol none <seglist> command to remove the protocol from the segment. Following is an example of the command. In this example, the terse form of the command is used.

```
10:ASN-9000:atm# sset proto none 2.2 Okay
```

In the above example, the RFC-1483 Encapsulation was removed from segment 2.2. To verify that the command was successful, issue the **config show** command. The segment is now available and can be configured for use by another protocol.

#### 2.2.5 RFC-1483 Encapsulation Configuration Example

In Figure 2.1, the PVC configuration sets up PVCs from ASN-9000 "A" to ASN-9000 "B" through FORE ATM Switch "C" and a PVC from "B" to "A" through "C". Because PVCs are unidirectional, a PVC must also be set in the reverse direction, from ASN-9000 "B" to ASN-9000 "A" through FORE ATM Switch "C."

Note that each link between the ASN-9000 and the FORE ATM Switch is an independent PVC, and so the same VCI number can be used the full length of the connection as long as the FORE ATM Switch is configured to map the VCIs through the correct ports. In this example, different VCIs are used in each PVC to create the connections: VCI 191 is used for the PVC between ASN-9000 "A" and FORE ATM Switch "C", and VCI 192 is used for the PVC between FORE ATM Switch "C" and ASN-9000 "B". In the other direction, VCI 193 is used for the PVC between ASN-9000 "B" and FORE ATM Switch "C", and VCI 194 is used for the PVC between FORE ATM Switch "C" and ASN-9000 "A."

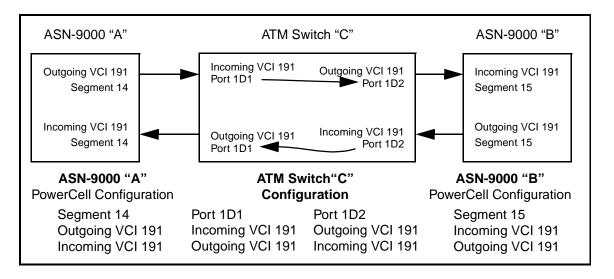


Figure 2.1 - Configuring PVCs from ASN-9000 "A" to ASN-9000 "B"

Note also that all commands must be issued from a management session on the *ForeRunner* ASN-9000 or switch that is being configured.

#### 2.2.5.1 FORE ATM Switch "C"

Here is an example of the commands you would issue in the FORE ATM switch to configure the PVCs on the ATM switch to match the configuration shown above. The first command in this example configures the PVC from port 1D1 to port 1D2. The second command sets up the PVC in the reverse direction, from port 1D2 to port 1D1.

```
localhost::configuration> vcc new 1D1 0 191 1D2 0 192 localhost::configuration> vcc new 1D2 0 193 1D1 0 194
```



On the ATM switch, do not type the name of the subsystem with the command if already in the subsystem. The example below shows two ways to issue the same command. The first issues the command from within the vcc subsystem, and the second from outside the vcc subsystem.

```
localhost::configuration vcc> new 1D1 0 191 1D2 0 192 localhost::configuration> vcc new 1D1 0 191 1D2 0 192
```

#### 2.2.5.2 Assigning PVCs to a Virtual Segment

To assign a PVC to a virtual segment, issue the following commands:

```
inpvc sset <vci> <seglist>
outpvc sset <vci> <seglist>
```

 $\textbf{sset} \qquad \text{Sets up the incoming or outgoing virtual channel ID}$ 

on the specified segment.

**<vci>** Specifies the name of the incoming or outgoing PVC

VCI.

**<seglist>** Specifies the segment to send or receive the PVC.

Following is an example of the inpuc sset command.

```
18:ASN-9000:atm/1483encap# inpvc sset 100 1.4
```

Following is an example of the outpvc sset command.

```
18:ASN-9000:atm/1483encap# outpvc sset 100 1.4
```

Following are the results produced by this command.

```
18:ASN-9000:atm/1483encap# outpvc sset 100 1.4
RFC-1483 encapsulation information for port 1.4
In PVC VCI: 100
Out PVC VCI: 25
Total Pkts sent: 25
Total Pkts rcvd: 322
Pkts rcvd with unknown type: 0
Pkts rcvd with unknown protocol: 0
Pkts rcvd with length too big: 0
```

The fields in this display show the following information:

In PVC VCI	Incoming PVC's VCI.
Out PVC VCI	Outgoing PVC's VCI.

Total Pkts sent Number of packets sent on this segment's outgoing

PVC. The PowerCell module begins accumulating these statistics when RFC-1483 encapsulation on a

segment is enabled.

**Total Pkts rcvd** Number of packets received on this segment's

incoming PVC. The PowerCell module begins accumulating these statistics when RFC-1483

encapsulation on a segment is enabled.

Pkts rcvd with unknown type Number of packets received on this segment's

incoming PVC with an unknown type. Any packet that does not contain a SNAP header and an OID of 0080c2 is considered a packet of unknown type.

Pkts rcvd with unknown protocol The PID which is not 0x0001, 0x0007, or 0x000e

(STP).

#### 2.2.5.3 ASN-9000 "A" PowerCell Module

Following is an example of the ASN-9000 commands issued to configure the segment on the PowerCell module for RFC-1483 Encapsulation. The atm sset protocol command in the following example configures PowerCell segment 1.4 on ASN-9000 "A" to use RFC-1483 Encapsulation.

```
13:ASN-9000_A:atm# sset proto b 1.4
```

Before segment 1.4 can begin switching traffic between the ATM network, the atm sset protocol command must be issued to enable RFC-1483 Encapsulation on the segment and configure the incoming and outgoing VCIs. Note that the incoming VCI number on the PowerCell segment must match the outgoing VCI number configured on the ATM switch. Likewise the outgoing VCI number on the PowerCell segment must match the incoming VCI number configured on the ATM switch.

```
14:ASN-9000_A:atm# sset proto b 1.4
```

After configuring the VCIs and enabling the segment for RFC-1483 Encapsulation, verify the configuration and display packet statistics using the atm/1483encap config show command, as shown in the following example.

```
15:ASN-9000_A:atm/1483encap# config show 1.4

RFC-1483 encapsulation information for segment 1.4

In PVC VCI: 194

Out PVC VCI: 191

Total Pkts sent: 25

Total Pkts rcvd: 322

Pkts rcvd with unknown type: 0

Pkts rcvd with unknown protocol: 0

Pkts rcvd with length too big: 0
```

#### 2.2.5.4 ASN-9000 "B" PowerCell Module

Repeat the process used to configure ASN-9000 "A" for the PowerCell Module in ASN-9000 "B". Use the same commands and use the VCI numbers that match the port numbers configured on the ATM switch that are connected to ASN-9000 "B". For the example, the command would be:

```
13:ASN-9000_B:atm# sset proto b 1.5
```

Then issue the atm sset protocol command to enable RFC-1483 Encapsulation on the segment and configure the VCIs. Note that the incoming VCI number on the PowerCell segment must match the outgoing VCI number configured on the ATM switch. Likewise the outgoing VCI number on the PowerCell segment must match the incoming VCI number configured on the ATM switch.

```
14:ASN-9000_B:atm# sset proto b 1.5
```

After configuring the VCIs and enabling the segment for RFC-1483 Encapsulation, verify the configuration and display packet statistics using the config show command, as shown in the following example.

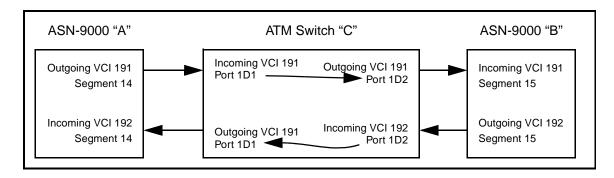
```
15:ASN-9000_B:atm# config show 1.5

RFC-1483 encapsulation information for segment 2.1
In PVC VCI: 192
Out PVC VCI: 193

Total Pkts sent: 34
Total Pkts rcvd: 652
Pkts rcvd with unknown type: 0
Pkts rcvd with unknown protocol: 0
Pkts rcvd with length too big: 0
```

#### 2.2.5.5 Selecting VCIs

In Figure 2.2, two different VCIs were used for the individual PVCs in each unidirectional connection between the two ASN-9000s. However, using the same VCI number along the length of a connection simplifies configuration and management of VCIs, PVCs, and connections. VCI 191 is used for both PVCs from ASN-9000 "A" to ASN-9000 "B", and VCI 192 is used for both PVCs from ASN-9000 "B" back to ASN-9000 "A".



**Figure 2.2 -** Selecting VCIs

## 2.2.6 Spanning-Tree on Bridged 1483

The Spanning-Tree algorithm is a mechanism that logically eliminates physical loops in a bridged 1483 network. For example, PVCs configured on two different segments through a switch from one PowerCell to another, forwards traffic on one segment loops back to the second segment. When this happens, the network has a loop.

Unless the network topology or the bridges in the network are reconfigured to break the loop, or implement a mechanism to logically break the loop, packets are forwarded from bridge to bridge indefinitely, clogging the network. Whenever a segment's state is changed, either by automatic segment-state detection or by a user-interface command, the Spanning-Tree algorithm adjusts the network topology accordingly.

To stop a loop in a 1483 bridged network, enable the Spanning-Tree algorithm using the spantree command in the bridge subsystem. For more information on how to enable the Spanning-Tree algorithm, refer to the ForeRunner ASN-9000 Software Reference Manual.

Figure 2.3 shows an example of a bridged 1483 network. Segment 1 on ASN-9000 "A" is configured with PVC 400 to segment 2 on ASN-9000 "B". Segment 2 on ASN-9000 "A" is configured with PVC 300 to segment 1 on ASN-9000 "B". After enabling the Spanning-Tree algorithm in the Bridge subsystem with the <code>spantree</code> command, use the <code>senable</code> command in the 1483encap subsystem to turn on Spanning-Tree for bridged PVCs. The first PVC segment configured is set to a forwarded state for traffic, while the second PVC segment is set to a blocking state eliminating any loopback of packets.

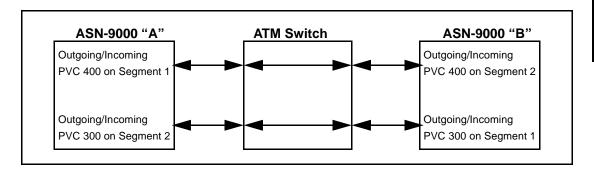


Figure 2.3 - Example Bridged 1483 Network

# CHAPTER 3

## **Routed 1483 over ATM**

This chapter describes ASN-9000 support for Routed 1483 over ATM. Routed 1483 (RFC 1483) allows the transmission of IP datagrams and Address Resolution Protocol (ARP) requests and replies over ATM using ATM Adaptation Layer 5 (AAL5).



Routed 1483, unlike Bridged 1483, supports multiple PVCs per virtual interface. Bridged 1483 allows only one PVC. In addition, Routed 1483 performs IP to PVC mapping statically. It does not support Signalling or ARPing of packets.

Normally, ATM connections in a Routed 1483 environment are established dynamically using User Network Interface (UNI) 3.0. ARP, Interim Local Management Interface (ILMI) and UNI 3.0 all work together as when setting up a Switched Virtual Connection (SVC). If a host or switch in a Logical IP Subnet (LIS) does not support UNI 3.0, however, it is not possible to establish an SVC. In this case, a Routed 1483 PVC can be used for communication.

On each of the Routed 1483 segments the <code>sset</code> command is used to establish the PVC. An unused VCI must be chosen for each Routed 1483 segment. PVCs using the chosen VCI must also be setup from each of the hosts to their connecting switch, and then on all of the switches between the two connecting switches.



Both the incoming and outgoing connections are set up simultaneously on the host, but they must be set up individually on the switches. The same VCI is used by a host to send on the PVC as well as receive on the PVC. The IP datagrams are sent over the PVC using AAL5 with LLC/SNAP encapsulation.

#### 3.1 PowerCell Module and Routed 1483

Routed 1483 networks contain the following components:

Logical IP Subnet (LIS)

A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. One LIS can be configured on each PowerCell segment used for Routed 1483. Individual members of the LIS are joined directly to other members using configured Permanent Virtual Circuits (PVCs). Hosts that are not members of the LIS can be reached only by using a LAN router (such as the ASN-9000).

The virtual interfaces that are created in Routed 1483 are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, when destined for any other interfaces on the ASN-9000, including another LIS on the same PowerCell.

Figure 3.1 shows an example of an ATM network using Routed 1483. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x with PVCs 100-104 on segment 1 and 147.128.20.x with PVCs 201-205 on segment 2. The subnet mask used in the following example is 255.255.255.0.

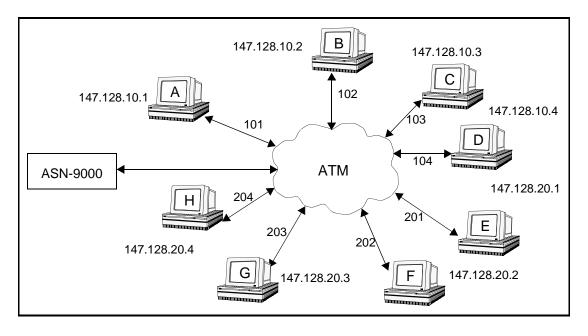


Figure 3.1 - Routed 1483 network.

Figure 3.2 shows stations E, F, G and H connected to segment 2 using Routed 1483. Configure a PVC to each of these hosts with its associated IP address.

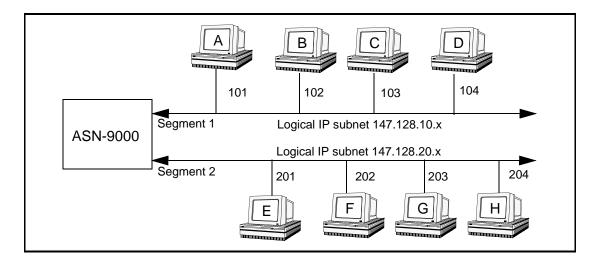


Figure 3.2 - Routed 1483 network containing LISs

Figure 3.1 and Figure 3.2 show two LISs connected to a PowerCell, installed in an ASN-9000. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell enables the LISs to communicate by routing IP traffic between the LISs. From the ASN-9000 in Figure 3.2, segment 1 connects with PVC 101 to station A, PVC 102 to station B, and so on, with logical IP subnet 147.128.10x.

#### 3.1.1 Routed 1483 PVC Support and Packet Encapsulation

The PowerCell can establish connections between members of an LIS using PVCs. After the PowerCell software establishes an PVC, the software encapsulates IP packets, using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5.

The default Maximum Transmission Unit (MTU) is 9,180 bytes. (When adding the SNAP header, the size becomes 9,188 bytes.). The maximum packet size is 9180. The same MTU size is used for all VCs in a LIS.

## 3.1.2 ATM ARP Support

To configure a PowerCell segment to use Routed 1483 specify the Virtual Connection (VC) using the routed1483 sset command described in Section 3.2.2. When configuring a PowerCell segment to support Routed 1483, the segment must be IP configured and routing must be enabled.

#### 3.1.2.1 Routed 1483 ARP Display

To display configured IP-PVC pairs for Routed 1483 segments, use the arp show command.

arp show <seglist>|all

**show** Displays the cache entries established.

<seglist>|all Displays the cache entries established on the

specified segment.

The following are the results produced by this command.

117:ASN-9000:atm/1483routed# arp show all

Configured PVCs and state:

IP Address PVC Segment

**IP Address** Indicates the configured destination IP address.

**PVC** Indicates the configured PVC.

**Segment** Displays the segment configured for PVC.

**State** The state always remains "VALID" in Routed 1483.

The following example shows PowerCell segment 5.2 configured for PVC with an IP address of 100.1.1.2. The state of the PVC is "VALID".

117:ASN-9000:atm/1483routed# arp show all

Configured PVCs and state:

#### **3.1.3 MTU Size**

The default MTU size for IP members operating over the Routed 1483 ATM network is 9180 octets. The LLC/SNAP header is 8 octets, therefore the default Routed 1483 ATM AAL5 protocol data unit size is 9188 octets. In Routed 1483 subnets, values other than the default can be used if, and only if, all members in the LIS have been configured to use the non-default value.

If a Routed 1483 packet is locally forwarded by the PowerCell from one LIS to another LIS attached to the same module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the ASN-9000 chassis), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long.

# 3.2 Configuring a PowerCell Segment for Routed 1483

To use a PowerCell segment for Routed 1483 routing in an ATM network, perform the following configuration tasks for each segment:

- Configure an IP interface on the segment (if not already done so) using the ip interface add command.
- Set the ATM protocol type to Routed 1483 using the atm sset protocol command.
- Enable IP routing.
- Specify the PVC and the IP address.

The following sections describe how to perform these tasks.

## 3.2.1 Configuration Considerations

Before configuring the PowerCell module for Routed 1483, make sure the configuration plans are not affected by the following considerations:

- Only one IP interface can be configured on a PowerCell segment enabled for Routed 1483.
- Broadcast traffic is not supported, as there is no mechanism in place to distribute broadcast packets. If the segments being configured require the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.
- One IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 Virtual Local Area Networks (VLANs) are not supported on PowerCell segments configured for Routed 1483. To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 on the segments.
- Do not include the segments being configured for Routed 1483 in ASN-9000 bridge (network) groups.

## 3.2.2 Configuring a Segment for Routed 1483 on ATM

Before enabling Routed 1483 on a segment, configure the PowerCell segment to use Routed 1483 using the atm sset protocol command. To configure the PowerCell segment to use Routed 1483, telnet into the ASN-9000 or connect through the TTY interface, change to the atm subsystem, and configure the desired segment using the following command:

sset proto[col] coto> <seglist>|all

<proto> Specifies the protocol to be used on a segment. To

configure the PowerCell segment to use Routed 1483

issue the following:

r1483[routed-1483]

**<segment-list>|all** Specifies the PowerCell segment is being configured

for Routed 1483. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If all is specified, all segments on all PowerCell modules in the chassis are

configured to use the Routed 1483 protocol.

After configuring the PowerCell segment to use Routed 1483:

• Specify the PVC and IP address to be used on the segment. (Do this before enabling Routed 1483 on the segment.)

• Enable Routed 1483 on the segment.

To perform these tasks, use the **sset pvc** and **senable** commands. The syntax for this command is:

sset <pvc> <destination-ip-address> <seglist>

**<pvc>** Specifies the PVC to be used on the segment. Valid

PVCs range between 32 and 1023.

<destination-ip-address> Specifies the destination IP address of the PVC.

<seglist> Specifies the PowerCell segment being configuried

for Routed 1483.

Following are some examples of the **sset pvc** and **senable** commands. The first sets the PVC on segment 5.2 and a revalidation time of 20 minutes. The second ignores the revalidation interval by defaulting to 15 minutes.

```
10:ASN-9000:atm/1483routed# sset 300 5.2
Okay
11:ASN-9000:atm/1483routed# senable 5.2
Segment 5.2 enabled
```

## 3.2.3 Removing Routed 1483 from a Segment

To remove Routed 1483 from a segment, perform the following steps:

- 1. Disable the segment using the sdisable command as described in Section 3.2.2.
- 2. Remove one or more configured PVCs from a segment, using the pdelete command. The pdelete command is used to delete a single PVCs or all of the PVCs from a Routed 1483 segment.
- 3. Undefine the protocol using the atm proto sset None command.

The following example shows how to perform these steps:

```
10:ASN-9000:atm/1483routed# sdisable all
Okay
11:ASN-9000:atm/1483routed# pdelete all
Okay
12:ASN-9000:atm# proto sset None all
Okay
```

#### 3.2.3.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network. Members outside of the LIS can be accessed only by a router.
- All members within the LIS must be able to communicate through ATM with all
  other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

# 3.3 Displaying the Routed 1483 Configuration

The current Routed 1483 configuration can be displayed using the config [show] command. Following is an example of the display produced by this command:

**PVC** Specifies the PVC associated with the segment.

State Indicates whether Routed 1483 is enabled or

disabled.

**Segment** Shows the segment running Routed 1483.

## 3.3.1 Displaying and Clearing Statistics

The current Routed 1483 statistics can be displayed using the **stats** [show] command. Following is an example of the display produced by this command:

```
117:ASN-9000:atm/1483routed# stats show 1.1
Displaying statistics from the ATM Card for segment 1.1
Routed-1483-Over-ATM Statistics for segment 1.1
_____
Connection Fails:
Total Control Packets In:
Total Control Packets Out:
Arp Replies In:
Arp Replies Out:
Total Arp Replies :
                               0
Arp Requests In:
                               0
Arp Requests Out:
Deleted Arp Replies:
                               Ω
Unknown Arp Replies:
Total InARP Requests:
Total ARP NAKs:
Total bad ARP operations:
Total times 1483routed restarted: 1
Unknown Packets received:
Unicast Data in:
                               17554
Bad ip packets in:
                               0
Unicast Packets dropped:
                               17553
Unicast packets forwarded:
```

The stats clear command can be used to clear Routed 1483 over ATM statistics. All learned entries are removed, but static entries (created using the sset atmarp command) remain in the table. These must be removed manually using the pdelete command.

#### Routed 1483 over ATM

This command can be used to help restabilize the network after a host is moved from one segment to another. When there is activity on the network, the cleared entries quickly reappear in the ATM ARP table, and a host that has been moved is relearned on its new segment.

A Routed 1483 segment is removed on the host side using pdelete command after disabling the PVC segment using the sdisable command. Both incoming and outgoing connections are removed simultaneously. The PVC must then be removed from each of the network switches involved.

# CHAPTER 4

# **LANE LEC Configuration**

The ASN-9000 supports ATM Forum Local Area Network Emulation (LANE) 1.0 and User-Network Interface (UNI) 3.0. These ATM protocol standards allow a logical segment on the ASN-9000 to be associated with an Emulated LAN (ELAN). An ELAN is a group of ATM stations that appear to the ASN-9000 as an Ethernet segment (broadcast domain). From the ASN-9000 perspective, ATM stations grouped into an ELAN appear to be nodes on a single Ethernet segment. Each ASN-9000 segment can be associated with a separate ELAN.

LANE 1.0 places Ethernet LANs on top of an ATM network. The PowerCell module can be used to overlay Ethernet and Fast Ethernet networks managed by the ASN-9000 onto ATM. Each logical segment on the PowerCell module is associated with an ELAN attached to the PowerCell module.

# 4.1 Ethernet LAN Characteristics Emulated by 1.0

LANE 1.0 emulates the following characteristics of Ethernet LANs:

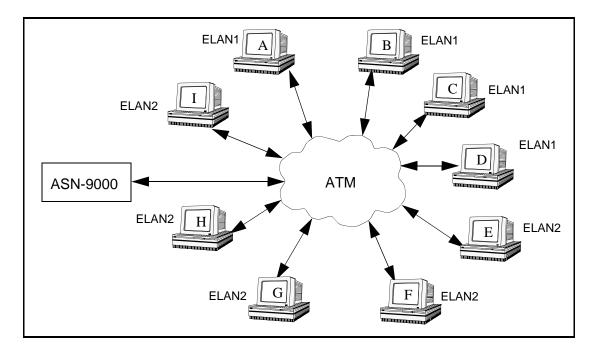
Connectionless service

LANE establishes VCs (virtual circuits) to bridge traffic between the Ethernet LAN and ATM, but the VCs are transparent to the Ethernet LAN equipment.

Broadcast and multicast service

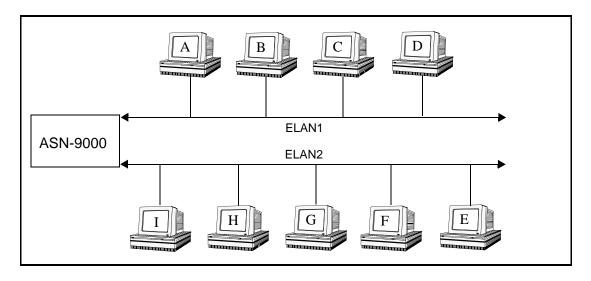
The Broadcast and Unknown Server (BUS) is a component of LANE that emulates broadcast and multicast services. When the PowerCell module needs to forward broadcast or multicast traffic from the Ethernet network, the module sends the traffic to the BUS, which in turn sends the traffic to each of the destination nodes in the ELAN.

Figure 4.1 shows an example of an ATM network using LANE 1.0. Notice that each ATM station is a member of an ELAN. In Figure 4.1, the stations are grouped into two ELANs: ELAN1 and ELAN2.



**Figure 4.1 -** ELANs on the ATM network.

Figure 4.1 shows the same ATM LANE 1.0 network from the ASN-9000 system's perspective. Notice that the ATM stations are still grouped into the same ELANs. However, the ASN-9000 regards each ELAN as an independent Ethernet segment. Figure 4.2 shows an ATM LANE 1.0 network containing ELANs— ASN-9000 view.



**Figure 4.2 -** *ForeRunner* ASN-9000 view of ELANs on the ATM LANE network.

Because ATM stations grouped in an ELAN appear to the ASN-9000 as members of a single Ethernet segment, all the configuration features and management features available on the ASN-9000 for Ethernet segments also are available for ELANs. The features include 802.1d bridging, the Spanning-Tree algorithm, IP, IPX, AppleTalk, and DECnet routing protocols, and ARP, as well as automatic segment-state detection, bridge groups, and VLANs.

#### 4.2 The PowerCell Module and LANE 1.0

The following sections describe the LANE 1.0 components and the role the PowerCell module plays in a LANE 1.0 network.

#### 4.2.1 LANE 1.0 Components

LANE 1.0 networks contain four major components:

LAN Emulation Client (LEC)

The LEC is the component in an end system that performs data forwarding, address resolution, and other functions when communicating with other components of an ELAN. A PowerCell segment can be configured as a LEC.

When a PowerCell segment is enabled as a LEC, the PowerCell performs data forwarding, address resolution, and other control functions when communicating with other components of the ELAN.

#### LAN Emulation Configuration Server (LECS)

The LECS is responsible for the initial configuration of a LEC. The LECS provides the LEC information about the ELANs that the LEC can join. The LECS also provides the LEC the address of the LES (see below) associated with each ELAN.

The LECS can be configured on an ATM host such as a UNIX workstation, or on a FORE Systems ATM switch.

#### LAN Emulation Server (LES)

The LES is a LAN Emulation ARP (LE\_ARP) server that contains address resolution information for an ELAN. The LES contains a table that maps the MAC address of each device in the ELAN to its corresponding ATM address.

The LES can be configured on the ATM switch or on the PowerCell 700.

# Broadcast and Unknown Server (BUS)

The BUS emulates multicast and broadcast functions of an Ethernet segment. When the LEC needs to send a broadcast or multicast packet, or does not know the destination of a unicast packet, the LEC sends the packet to the BUS. The BUS then floods the packet to the appropriate end systems. The BUS can be configured on the ATM switch or on the PowerCell 700.

## 4.2.2 Using a PowerCell Module with LANE 1.0

Figure 4.3 shows an example of an ATM switch connected to multiple LANE 1.0 ELANs. In this configuration, the ATM switch cannot directly bridge or route traffic from one ELAN to another.

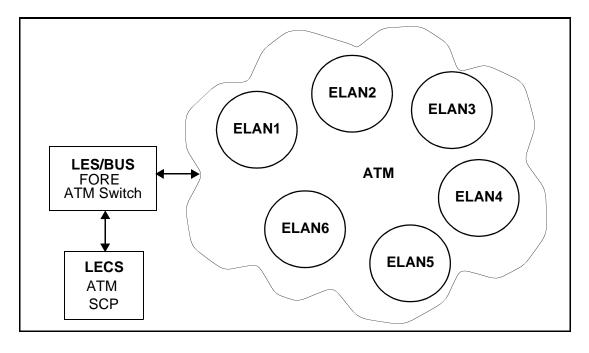
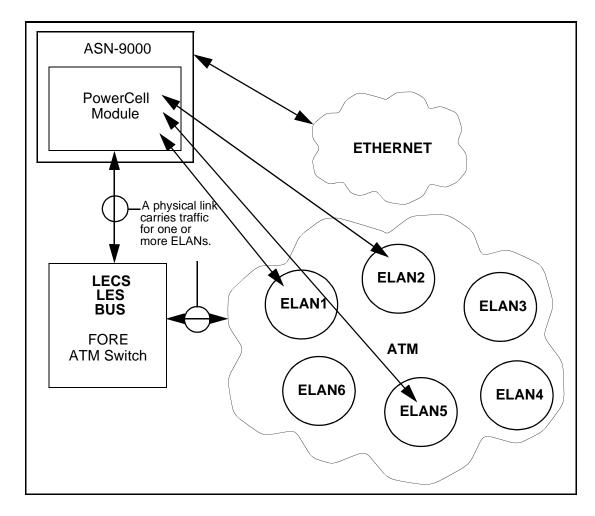


Figure 4.3 - ELANs Configured On A Switch

In Figure 4.3, the ATM switch is switching traffic between LECs on an ELAN. However, the ATM switch cannot bridge or route from one ELAN to another without an ASN-9000. For example, traffic from ELAN1 cannot be bridged or routed to ELAN2. Figure 4.4 shows how adding the PowerCell module to the ATM network enables bridging and routing among LANE 1.0 ELANs.



**Figure 4.4 -** Bridging and routing among LANE 1.0 ELANs.

As shown in Figure 4.4, a PowerCell module has been added to the ATM network. LANE 1.0 traffic from one ELAN to another is sent by the ATM switch to the PowerCell, which uses its on-board ATM processing software to forward the traffic to the appropriate ELAN. For example, traffic sent from ELAN1 to ELAN2 is received by the ATM switch, which sends the traffic to the PowerCell module. The PowerCell module receives the LANE 1.0 packets, removes the LANE 1.0 headers, then examines the destination and source addresses of the packet for forwarding information.

Traffic sent from the ASN-9000 to devices in an ELAN are translated by the PowerCell module from Ethernet packets into ATM cells, then sent to the ELAN.

#### 4.3 Local LES and BUS

A LES or BUS configured on the PowerCell 700 is called a local LES or local BUS. Depending upon configuration needs, both the LES and BUS can be configured on the PowerCell 700 or just one or the other. If both the LES and the BUS are configured on the PowerCell module, the LES and BUS are called colocated.

A colocated LES and BUS share address resolution information. Therefore, by colocating the LES and BUS, the forwarding of unknown packets provided by the LES and BUS can be optimized.

To configure a LES or BUS or a colocated LES and BUS on the PowerCell 700, use the procedure in Section 4.4.3.

# 4.4 Configuring for LANE 1.0

To use the PowerCell module for bridging and routing in a LANE 1.0 ATM network, the following configuration tasks must be performed:

- Prepare the other ATM hardware for LANE 1.0. For more information on preparing the other ATM hardware, see the ForeRunner ASN-9000 Hardware Reference Manual.
- Add ELANs to the segments allocated to the PowerCell module. The ELAN
  names assigned to a segment must match the ELAN names specified when the
  LECS was configured on the ATM switch. (Use the elan add command.)
- The elan add command enables the LEC automatically. Specify the LECS address with either the elan add or the lecs cset command. By default, the PowerCell module uses the LECS Well Known Address (If the LECS is not used to get configuration information, specify the LES address when adding an ELAN to the LEC.).

## 4.4.1 Configuring Other ATM Hardware for LANE 1.0

The following sections describe how to configure ATM hardware for LANE 1.0.

#### 4.4.1.1 LES and BUS

If a PowerCell segment is to be used as a LEC for LANE 1.0, the LES and BUS must be defined within the ATM network

The LES and BUS can be configured on the ATM switch, on a UNIX workstation configured with an ATM Adapter Card, ASN-9000, or on the PowerCell 700.

The following sections describe how to configure a FORE Systems ASX ATM Switch, SBA-200 Adapter Card, and a PowerCell 700. Each procedure contains steps for configuring the LES and BUS. The LES and BUS need to be configured on only one device for each ELAN supported by the devices.

• Configure the LES and BUS on the PowerCell 700 (refer to Section 4.4.3).

#### 4.4.1.2 LECS

The LES and BUS are required, the LECS is optional. The LECS supplies the LES address to the LEC (PowerCell module). If the LECS is not configured, the LES address must be supplied manually when adding an ELAN to the PowerCell module. Note that the LECS cannot be created on the ASN-9000. It must be located on the ATM Switch or a host with an ATM adapter card.

The following sections contain configuration instructions for bringing up LANE 1.0 services on a FORE Systems SBA-200 Adapter Card and ATM switch. For further information about how to configure the other configuration items, refer to the *ForeRunner ATM Switch Configuration Manual*.

#### 4.4.2 Configuring the PowerCell Module for LANE 1.0

The following sections describe the commands used to configure the PowerCell module for LANE 1.0. The commands used to configure the PowerCell for LANE 1.0 are located in the atm/lane subsystem. To access the atm/lane subsystem, issue the following command at the runtime prompt:

atm/lane

## 4.4.3 Configuring the LES and BUS on the PowerCell 700

Using the commands described in the following sections, the LES, the BUS, or a colocated LES/BUS pair can be configured on the PowerCell 700. In addition to the commands described in the following sections, the ASN-9000 contains commands for displaying LES and BUS statistics and deleting a LES or BUS (refer to Section 4.4.3.6).

#### 4.4.3.1 Configuring a Colocated LES and BUS

To configure a colocated LES and BUS on the PowerCell 700, issue the following command:

les add <les-elan-name> <slot> <les-SELbyte>
 <bus-SELbyte|bus-atm-address> [[rg=]<rate-group>]
[-type](ethernet|token-ring) [-mtu(1516|4544|9234)]

<les-elan-name> Specifies the ELAN that the LES, BUS, or LES/BUS

pair being created serve. Specify an alphanumeric

name from 1 to 32 characters in length.

**<slot>** Specifies the slot containing the PowerCell 700. The

slots are labeled on the-9000 chassis. Slot numbers can also be determined by using the system config

show command.

<les-SELbyte> Specifies the Selector byte of the LES. The Selector

Network Services Access Point (NSAP) ATM address. The hexadecimal digits can be specified alone or use "0x" to flag them. In either case, the

software assumes that the digits are hexadecimal.

Specifies the Selector byte of the BUS or address. The hexadecimal digits can be specified alone or use "0x" to flag them. In either case, the software assumes that

the digits are hexadecimal.

To create a colocated LES/BUS, do not specify the full ATM address of the BUS.

<rate-group> Specifies the maximum amount of traffic that can be

transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155

mbps. Up to 16 rate groups can be specified.

[-type](ethernet|tokenring) Specifies the type of encapsulation in use by the LES.

[-mtu(1516|4544|9234)] Specifies the maximum size of the MTU.

<bus-SELbyte|bus-atm-address>

The following example shows a colocated LES/BUS being added to the PowerCell 700 in slot 1.1. Because only the Selector byte of the BUS is specified, the ASN-9000 assumes a colocated LES/BUS and creates one. The LES/BUS serves the ELAN named "engineering."

4:ASN-9000:atm/lane# les add engineering 1.1 0x10 0x20

#### 4.4.3.2 Configuring an Independent NSAP LES

To configure an independent NSAP LES on the PowerCell 700, issue the following command:

<les-elan-name> Specifies the ELAN that the LES, BUS, or LES/BUS

pair serve. Specify an alphanumeric name from 1 to

32 characters in length.

<slot> Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis. Slot number can also be determined by using the system config show

command.

<Service-ID> Specifies the 8-digit Service Identifier (decimal

notation or prefix with a "0x" for hex. notation). This ID is used to construct an ATM address where the service can be located independent of the physical topology. Both the LES and BUS are created under

this usage.

[rg=]<rate-group> Specifies the maximum amount of traffic that can be

transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155

mbps. Up to 16 rate groups can be defined.

**[-type](ethernet|token-ring)** Specifies the type of encapsulation in use by the LES.

[-mtu(1516|4544|9234)] Specifies the maximum size of the MTU.

In the following example, a LES for an ELAN called "marketing" is added to the PowerCell 700 in slot 2. The Selector byte of the LES is 30 (hexadecimal). Because the BUS is on another device, the full ATM address of the BUS is specified. By specifying the ATM address of the BUS, the LES is informed of the location of the BUS in the ATM network.

atm/lane# les add marketing 2 0x30 47:0005:80ff:e100:0000:f21a:2c00:0000ef042990:20

#### 4.4.3.3 Deleting a Configured LES

To delete the LES configured on the PowerCell 700, issue the following command:

les delete <les-elan-name> <slot>

**<les-elan-name>** Specifies the name of the ELAN that the LES serves.

**<slot>** Specifies the slot containing the PowerCell 700. The

slots are labeled on the chassis.

#### 4.4.3.4 Configuring a BUS

To configure a BUS (not a colocated LES/BUS) on the PowerCell 700, issue the following command:

**<br/>bus-elan-name>** Specifies the name of the ELAN that the BUS serves.

Specify an alphanumeric name from 1 to 32

characters in length.

**<slot>** Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis. Slot numbers can also be determined by using the system config show

command.

**<bus-SELbyte>** Specifies the Selector byte of the BUS. The Selector

byte is the final two hexadecimal digits in an NSAP ATM address. Specify the hexadecimal digits alone or use "0x" to flag them. In either case, the software

assumes that the digits are hexadecimal.

**[rg=]<rate-group>** Specifies the maximum amount of traffic that can be

transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155

mbps. Up to 16 rate groups can be defined.

**[-type](ethernet|token-ring)** Specifies the type of encapsulation in use by the LES.

[-mtu(1516|4544|9234)] Specifies the maximum size of the MTU.

In the following example, a BUS is added to the PowerCell 700 in slot 1 for an ELAN named "MAGIC-BUS." The Selector byte for the BUS is 20 (hexadecimal). In this example, the "0x" used to denote a hexadecimal address is omitted. The "0x" is optional.

4:ASN-9000:atm/lane# bus add MAGIC-BUS 1 20

#### 4.4.3.5 Deleting a BUS

To delete a configured BUS, issue the following command:

bus delete <bus-elan-name> all <slot>

**<buse>selan-name>|all**Specifies the name of the ELAN that the BUS serves.

<slot> Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis.

#### 4.4.3.6 Displaying the LES and BUS Configuration

After configuring a LES, a BUS, or a colocated LES/BUS on the PowerCell 700, the configuration can be displayed by issuing the following command:

les [show] <service-name>|all <slot>|all
bus [show] <service-name>|all <slot>|all

<service-name>|all

Specifies the name of the ELAN that the LES, BUS, or LES/BUS pair serves. If all is specified, configuration information on all the LESs, BUSs, and colocated LES/BUSs on the PowerCell 700 in the specified slot is displayed.

<slot>|all

Specifies the slot containing the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the system config show command. If all is specified, configuration information on all the LESs, BUSs, and colocated LES/BUSs on all PowerCell 700 Modules in the ASN-9000 chassis is displayed.

Following are some examples of the information displayed by this command. In the first example, summary information for all the LES and BUS services configured on the PowerCell 700 is displayed:

```
4:ASN-9000:atm/lane# bus show all all
Services on slot 1
Slot Name Service Type LES-SEL BUS-SEL Rate Group
---- 1 sales Colocated LES/BUS 0x10 0x20 1
```

The fields in this display show the following information:

Slot Indicates the slot containing the PowerCell 700 on which the listed service is configured.

Name Indicates the name of the ELAN served by the LES or

BUS.

**Service Type** Indicates the service type. The service can be a BUS, a

LES, or a colocated LES/BUS.

SEL Indicates the Selector byte of the LES, BUS, or

colocated LES/BUS.

In the following example, detailed information for a specific LES (for the ELAN "engineering") is displayed. Detailed information is displayed only when information about a specific service is requested. If information for more than one service is requested, summary information is displayed:

```
\begin{tabular}{ll} 4: ASN-9000: atm/lane \# \begin{tabular}{ll} les & show & engineering \\ 1 \\ LES & Configuration & for: & engineering \\ \end{tabular}
```

```
LES ATM Address: 47:0005:80ff:e100:0000:f21a:2d09:0020481a2d09:10
BUS ATM Address: 47:0005:80ff:e100:0000:f21a:2d09:0020481a2d09:10
Proxy Party Count : 1
```

Proxy PMP VPI : 0
Proxy PMP VCI : 84
Non-Proxy PMP VPI : 0
Non-Proxy PMP VPI : 0
Non-Proxy PMP VCI : 0

The fields in this display show the following information:

LES ATM Address	Indicates the ATM address of the LES.

BUS ATM Address	Indicates	the	$\Delta TM$	address	οf	the	RUS	associated

with this LES.

**Proxy Party Count** Indicates how many ATM hosts that are proxies are

served by the LES.

Proxy PMP VPI For proxy hosts, shows the Point-to-Multipoint

(PMP) VPI the LES is using.

**Proxy PMP VCI** For proxy hosts, shows the PMP VCI the LES is

using.

**Non-Proxy Party Count** Indicates how many ATM hosts that are not proxies

are served by the LES.

**Non-Proxy PMP VPI** For non-proxy hosts, shows the PMP VPI the LES is

using.

**Non-Proxy PMP VPI** For non-proxy hosts, shows the PMP VPI the LES is

using.

**Non-Proxy PMP VCI** For non-proxy hosts, shows the PMP VCI the LES is using.

```
4:ASN-9000:atm/lane# bus show eng-BUS 1
BUS Configuration for: eng-BUS

BUS ATM Address: 99:9999:9999:9999:9999:0000ef043480:20
BUS FORWARDING RATE GROUP: 1
BUS PARTY COUNT: 1
BUS PMP VPI: 0
BUS PMP VCI: 79
```

The fields in this display show the following information:

**BUS ATM Address** Indicates the ATM address of the BUS.

BUS Forwarding Rate Group Indicates the BUS forwarding rate group associated

with the defined rate group.

**BUS Party Count** Indicates how many ATM hosts that are proxies

served by the BUS.

BUS PMP VPI Indicates the PMP VPI the BUS is using.

BUS PMP VCI Indicates the PMP VCI the BUS is using.

#### 4.4.3.7 Displaying BUS Statistics

To display BUS statistics for a BUS configured on the PowerCell 700, issue the following command.

stats	show l	bus	<pre><service-name></service-name></pre>	lall	<slot></slot>	lall

<service-name>|all Shows the service BUS configuration for the

PowerCell module in the specified slot.

**<slot>|all** Is the slot containing the PowerCell 700. Slots are

labeled on the chassis. If all is specified, statistics for all the BUSs on all PowerCell 700 Modules are

displayed.

#### Here is an example of this command:

```
4:ASN-9000:atm# stats show bus elan 1
BUS Statistics For ELAN: elan1
```

Unicast Data In : 2
Multicast Data In : 2
Known Control In : 0
Unknown Control In : 1

The fields in this display show the following information:

**Unicast Data In** Indicates how many packets of unicast data the BUS

for ELAN1 has received.

Multicast Data In Indicates how many packets of multicast data the

BUS has received.

**Known Control In** Indicates how many control packets of a known type

the BUS has received.

**Unknown Control In** Indicates how many control packets of an unknown

type the BUS has received.

#### 4.4.3.8 Displaying LES Statistics

To display LES statistics for a LES configured on the PowerCell 700, issue the following command.

stats [show] les <service-name> | all <slot> | all

PowerCell module in the specified slot.

**<slot>**|**all** Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis. If all is specified, statistics for all LESs on all PowerCell 700 Modules

in the are displayed.

Here is an example of this command:

4:ASN-9000:atm# stats show les engineering 1

ELAN Name: "elan1"

Join Request In : 1

ARP Requests In : 1

ARP Responses Out : 1

ARP Requests Forwarded : 1

Unknown Control In : 1

The fields in this display show the following information:

Join Requests In Indicates a LEC request to join the LES.

ARP Requests In 
Indicates the number of LE\_ARP requests received

on this ELAN by the PowerCell module.

ARP Responses Out Indicates the number of LE\_ARP responses sent on

this ELAN by the PowerCell module.

on this ELAN by the PowerCell module.

**Unknown Control In** Indicates the number of control packets of an

unknown type the LES has received.

#### 4.4.3.9 Clearing BUS Statistics from the PowerCell 700.

To delete statistics for a BUS that configured on the PowerCell 700, issue the following command:

stats clear bus <service-name>|all <slot>|all

<service-name>|all Clears the service BUS configuration for the

PowerCell module in the specified slot.

<slot>|all Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis. If all is specified, statistics for all BUSs on all PowerCell 700 Modules

in the are cleared.

#### 4.4.3.10 Clearing LES Statistics from the PowerCell 700

To delete statistics for a LES that configured on the PowerCell 700, issue the following command:

stats clear les <service-name>|all <slot>|all

<service-name>|all Clears the service LES configuration for the

PowerCell module in the specified slot.

**<slot>|all** Specifies the slot containing the PowerCell 700. Slots

are labeled on the chassis. If all is specified, statistics for all BUSs on all PowerCell 700 Modules

in the are cleared

#### 4.4.4 Adding an ELAN

The elan add command allows is used to add ELANs to PowerCell segments. To configure the required segments for LANE 1.0, issue the atm sset protocol command. When the segments are allocated, the PowerCell LEC can be joined to an ELAN. Issue the following command to associate a PowerCell segment with the ELAN you want to join:



Disabled any segments configured as FORE IP before adding them to an ELAN.

### 

<segment> Specifies the segment of the ELAN to add

(<*slot*>.<*seg#*>, where <*seg#*> is from 1 to 32).

**<elan-name>** Specifies the name of the ELAN to add.

la<les-atm-address> Specifies the ELAN LES address. The les-address

parameter is required when the LECS has not been configured or when the LECS usage is not set. The LE Client forms a connection directly to the specified

LES instead of the LECS.

**lu<lecs-atm-address>** Specifies the LECS to be used by the LE Client. When

the lecs-usage parameter is used, the well known address is not used, but a LECS is enabled using the address provided. This parameter is used when the LECS is not located at the well-known address, and

the les-address parameter is not set.

The following example shows how to add an ELAN to the PowerCell segment. In this example, an ELAN named "elan1" is added to segment 1.6, the segment is enabled and the LECS is connected using the LECS well-known address.

5:ASN-9000:atm/lane# elan add 1.6 elan1

A particular ELAN can be added to only one PowerCell segment and the ELAN name must be unique among the PowerCell segments in the same ASN-9000. In addition, the ELAN name specified must match the ELAN name configured in LECS.

If the LECS has not been configured, the LES address must be specified when adding the ELAN to the PowerCell module. The following example shows how to specify the LES address:

atm/lane# elan add 1.6 elan1 la 47:0079:0000:0000:0000:0000:0000:00003e000001:00

### 4.4.4.1 Changing ELAN Parameters

The elan set command is used to change the default for an ELAN parameter. Current settings for each parameter can be displayed using the elan show command. The LECS configuration file on the FORE ATM switch contains parameters similar to the ELAN parameters maintained by the PowerCell module. Most of the PowerCell defaults for the parameters match the defaults for the FORE LECS equivalents to these parameters. FORE Systems recommends that the defaults for these values be used. Setting parameters on the ASN-9000 overwrites values supplied by the LECs. The syntax for the elan set command is:

elan set <elan-name>|all arp-aging|aa <time>

elan set <elan-name>|all bus-rate|br <packets per second>
elan set <elan-name>|all control-timeout|cto <time>
elan set <elan-name>|all flush-timeout|fto <time>
elan set <elan-name>|all forward-delay|fd <time>
elan set <elan-name>|all max-arp-retry|mar <count>
elan set <elan-name>|all vcc-timeout|vto <time>

ELAN parameters. If **all** is specified, the parameters are applied to all the ELANs in the ASN-9000.

Specify one of the following parameters with the **elan set** command with the value assigned to the parameter:

arp-aging|aa <time> Specify from 10 through 300 seconds. The default is

**300**. The corresponding parameter in the LECS file is

.Aging\_Time.

bus-rate|br <packets per second> Specify from 0 through 10 Packets Per Second. The

default is 1. The corresponding parameter in the LECS file is .Maximum\_Unknown\_Frame\_Time.

<control-timeout|cto <time> Specify from 10 through 600 seconds. The default is

**120**. The corresponding parameter in the LECS file is

.Control\_TimeOut.

flush-timeout|fto <time> Specify from 1 through 10 seconds. The default is 6.

The corresponding parameter in the LECS file is

.Flush\_TimeOut.

<forward-delay|fd <time> Specify from 4 through 30 seconds. The default is

**15**. The corresponding parameter in the LECS file is

.Forward\_Delay\_Time.

max-arp-retry|mar < count> Specify from 0 through 2 requests. The default is 2.

The corresponding parameter in the LECS file is

.Maximum\_Retry\_Count.

vcc-timeout|vto <time> Specify from 1 through 720 minutes. The default is

**20**. The corresponding parameter in the LECS file is

.VCC TimeOut Period.

## 4.4.5 Displaying an LE\_ARP Table for an ELAN

The ASN-9000 maintains a separate LE\_ARP table for each ELAN on a PowerCell module. The LE\_ARP table maps the MAC addresses of the devices in an ELAN to their corresponding ATM addresses. To display the LE\_ARP table for an ELAN, issue the following command:

elan=<elan-name>|addr=<mac-

address>lall

Specifies an ELAN name or MAC address. If all is specified, LE ARP table entries for all the ELANs on all the PowerCell modules are displayed.

The following examples show the information displayed by this command. In the following example, the LE ARP table entries for "elan1" are displayed.

at [show] elan=<elan-name>|addr=<mac-address>|all

5:ASN-9000:atm# at show elan=elan1

ARP Table For ELAN: elan1

Seg.	MAC Address	ATM Address
1.3	00-20-48-1a-1e-3c	47:0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:10
1.4	00-20-48-1b-1f-3d	47:0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:02

In the following example, a MAC address is specified. The ELAN name and ATM address corresponding to the MAC address are listed.

6:ASN-9000:atm# at show 00-20-48-1a-1e-3c

ARP Table For MAC Address: 00-20-48-1a-1e-3c

Seg.	Elan Name	ATM	Address
1.9	elan1	47:0	0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:10

The fields in this display show the following information:

Seg Indicates the segment on which the ELAN is

configured.

Indicates the MAC address of a LANE 1.0 device. MAC Address

Indicates the name of the ELAN. Elan Name

Indicates the ATM address of a LANE 1.0 device. ATM Address

## 4.4.5.1 Clearing the LE ARP Table

To clear an ELAN's LE\_ARP table, issue the following command:

at clear <elan-name> all

<elan-name>|all Specifies the name of the ELAN to clear the LE\_ARP

table. If all is specified, ARP tables for all the ELANs on all PowerCell modules are cleared.

## 4.4.6 Displaying the Virtual Circuits on an Elan

To display the VCs (Virtual Circuits) in use on an ELAN, issue the following command:

vt [show] <elan-name> all

elan-name>|all

Specifies the name of the ELAN for which you want to display the VC table. If you specify all, the active VCs on all the ELANs on all PowerCell modules in the *ForeRunner* ASN-9000 chassis are displayed.

Here is an example of the information displayed by this command. In this example, the VC for "elan1" is displayed.

The fields in this display show the following information:

Seg Indicates the segment on which the ELAN is

configured.

**MAC Address** Indicates the MAC address of the device at the other

end of the VC.

VC Indicates the number of the VC connecting the ELAN on the PowerCell module to the other device. The VC number is negotiated by the PowerCell module and the ATM switch when the VC is

established. The number can be different for each VC

VC.

## 4.4.7 Displaying Statistics

The PowerCell module collects statistics for the data and control traffic sent and received by the ELANs configured on the PowerCell module. All statistics are collected on a per-ELAN basis.

- Statistics for data traffic are collected as interface statistics because the ELAN data packets are processed on the interface layer.
- Statistics for ATM control traffic are collected as ELAN statistics because they are processed on the ELAN layer.

To display ATM statistics, issue the following command:

### stats [show] elan <elan-name>|all elan|if|all

statistics. If all is specified, statistics for all ELANs

are displayed.

**elan|if|all** Specifies the statistics to displayed.

elan Displays ELAN (control) statistics.

if Displays interface (data) statistics.

all Displays ELAN and interface statistics.

The following example shows the interface statistics. In this example and the following example, statistics are displayed for an ELAN named "elan1."

8:ASN-9000:atm# stats show elan1 if

Interface Statistics For ELAN: elan1

Out MCast Pkts	:	1
Out Errors	:	0
Out Discard	:	0
Out UCast Pkts	:	1
In MCast Pkts	:	0
In Errors	:	0
In Discard	:	0
In UCast Pkts	:	0
In Unknown Protos	:	0
MTU size	:	1514

The fields in this display show the following information:

Out MCast Pkts Indicates the number of Ethernet broadcast on	r
--	---

multicast packets the ELAN has sent to the ATM

network.

**Out Errors** Indicates the number of Ethernet packets sent by the

ELAN that experienced an error during

transmission.

Out Discard Indicates the number of Ethernet packets that were

discarded due to an error on the PowerCell module,

rather than sent to the ATM network.

**Out UCast Pkts** Indicates the number of Ethernet unicast packets the

ELAN has sent to the ATM network.

In MCast Pkts Indicates the number of Ethernet broadcast or

multicast packets the ELAN has received from the

ATM network.

**In Errors** Indicates the number of Ethernet packets received by

the ELAN that contain errors.

In Discards Indicates the number of Ethernet packets that were

discarded due to an error in the PowerCell module,

rather than received for the ELAN.

**In UCast Pkts** Indicates the number of Ethernet unicast packets the

ELAN has received from the ATM network.

In Unknown Protos Indicates the number of Ethernet packets received

that were using an unknown protocol.

MTU size Indicates the MTU (maximum transmission unit) for

the protocol being used in the ELAN.

The following example shows the ELAN statistics displayed for an ELAN.

9:ASN-9000:atm# elan show elan1 elan

ELAN Statistics For ELAN: elan1

\_\_\_\_\_\_

SVCs Released : 1
Total Control In : 5
Total Control Out : 5
ARP Replies In : 2
ARP Replies Out : 0
ARP Request In : 0
ARP Request Out : 2
Join ELAN Calls : 1

The fields in this display show the following information:

SVCs Released Indicates the number of SVCs that have been

released (torn down) by this ELAN. An SVC is released after the two ends of the SVC (the ELAN on the PowerCell module and the device on the other

end) stop exchanging traffic.

**Total Control In** Indicates the number of LANE 1.0 control packets

received on this ELAN by the PowerCell module.

**Total Control Out** Indicates the number of LANE 1.0 control packets

sent on this ELAN by the PowerCell module.

**ARP Replies In** Indicates the number of LE\_ARP replies received on

this ELAN by the PowerCell module.

ARP Replies Out Indicates the number of LE\_ARP replies sent on this

ELAN by the PowerCell module.

ARP Request In Indicates the number of LE\_ARP requests received

on this ELAN by the PowerCell module.

**Arp Request Out** Indicates the number of LE\_ARP requests sent on

this ELAN by the PowerCell module.

PowerCell module has requested to join the like-

named ELAN configured on the ATM switch.

## 4.4.8 Clearing Statistics

To clear ATM statistics, issue the following command:

stats clear elan <elan-name> all

statistics. If all is specified, statistics for all the

ELANs in the ASN-9000 are cleared.

# 4.5 LEC Failover Support

The ASN-9000 supports *ForeThought's* LEC failover mechanism. The LEC failover mechanism provides redundancy by allowing an ELAN to be associated with multiple LESs. The ELAN uses only one of the LESs for ELAN traffic, but if that LES fails, the software automatically uses another LES. Up to two backup LESs can be specified for each ELAN. The next section describes how to implement the LEC failover mechanism on the PowerCell module.

## 4.5.1 Implementing the Failover Mechanism

To implement the failover mechanism for an ELAN, perform the following:

1. Add the LES/BUS pairs. Up to three LES/BUS pairs can be added to a PowerCell module, ATM switch, or Host where the LES/BUS is to reside. To assign an instance, use a vertical bar (|) to separate the ELAN name from the LEC instance. If a LECS is not being used, include the full ATM NSAP address of the LES. To configure a LES/BUS pair on a PowerCell segment, use the les add command.

- 2. Configure the LECS. The LECS must be configured to match the LES/BUS selector bytes and instances for each ELAN. This must be done unless no LECS is to be used in the ELAN, in which case the full LES/BUS ATM NSAP address (and not just selector byte) must be specified in the ELAN configuration step. To configure a LECS, refer to the *ForeRunner ATM Switch Configuration Manual*, or the *ForeRunner SBA-200 ATM SBus Adapter User's Manual*, if using FORE Systems ATM equipment.
- 3. Configure the ELAN instances. Again, use the same ELAN name with a vertical bar (|) to separate the ELAN name from the LES instance with the same segment number of the LEC.

All three instances of the ELAN name reside on the same PowerCell segment, but only one instance is active. The ASN-9000 implementation of the failover mechanism is transparent to ASN-9000 bridging and routing. ASN-9000 bridging and routing software continue to use the same segment number for the ELAN, regardless of the LES instance that is active. Figure 4.5 shows an example of how the failover mechanism is used on the PowerCell module.

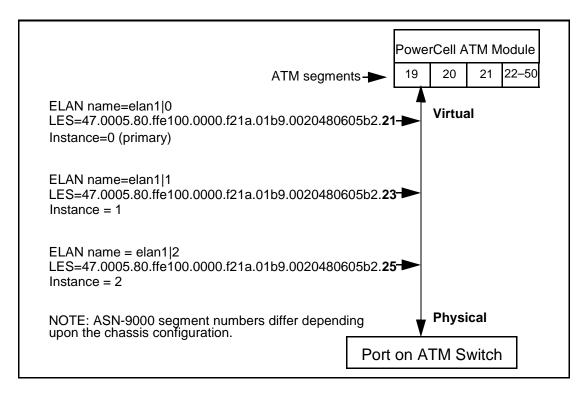


Figure 4.5 - Example of Failover Mechanism

In Figure 4.5, three instances of elan1 have been added to PowerCell segment 19 as three distinct ELANs: elan1 | 0, elan1 | 1, and elan1 | 2. A LES address has been specified for each instance, either using the ASN-9000 elan add command or using entries in the LECS configuration file.

The LESs are distinguished in this example by the Selector bytes (21, 23, and 25). The LES address is specified, including the Selector bytes, when adding an ELAN to a PowerCell segment. The LES addresses can be specified when adding the ELANs to the PowerCell module. However, the LES addresses on the PowerCell module do not need to be specified if a LECS is being used and the LES addresses have been specified (and failover instances) in the LECS configuration file.

After the failover mechanism switches to LES instance 1 (the backup LES), the software periodically attempts to re-establish connection to the primary LES (instance 0). When a LES fails, or when the failover mechanism attempts to re-establish connection to the primary LES, traffic on the PowerCell module is momentarily interrupted while the software establishes VCs to the new LES and flushes the LE\_ARP, bridge, and route caches on the module.

Use the commands in the following sections to implement the LEC failover mechanism on the PowerCell module. These commands implement the failover feature in the PowerCell module only. To implement the failover mechanism on the ATM switch, refer to the documentation for the respective ATM switch.

### 4.5.1.1 Preparing the LECs for the Failover Mechanism

Before adding the ELAN to the PowerCell segments, add the desired LES/BUS pairs on two different nodes and implement the failover mechanism in the LECS configuration file. Use the les add command to configure the LES/BUS pairs. Refer to the *ForeRunner ATM Switch Configuration Manual*, or the *ForeRunner SBA-200 ATM SBus Adapter User's Manual* for information on configuring the LECS.

### 4.5.1.2 Determining Which LES and BUS Are in Use

The **elan** [show] command can be issued at any time to determine which LES and BUS an ELAN is using.

LANE LEC Configuration

## 4.5.2 Verifying the PowerCell LANE 1.0 Configuration

After configuring the PowerCell module as a LEC, the LEC software on the module serves all the ATM segments on that module that are configured for LANE 1.0. To show the LEC that is to be used by all the LECs, issue the following command:

lec [show] <slot> all

**<slot>|all** Specifies the slot containing the PowerCell module.

Slots are labeled on the chassis. Slot numbers can also be determined by using the system config show command.

If all is specified, the LEC configuration for all the PowerCell modules in the chassis is displayed.

The following example shows the information displayed by this command. The "LE Client" is the LEC (PowerCell module).

8:ASN-9000:atm/lane# lec show 4 LEC Configuration For slot: 4

\_\_\_\_\_\_

LE Client State : Enabled

LE Client ATMAdd:47:0005:80ff:e100:0000:f21a:1e3c:0000ef0282d0:00 LECS ATM Address: 47:0079:0000:0000:0000:0000:0000:00003e000001:00

The fields in this display show the following information:

**LE Client State** Indicates whether the PowerCell module is enabled

as a LEC.

**LE Client ATM Address** Indicates the ATM address of the PowerCell module.

The address displayed is the base address of the LEC (PowerCell module). The Selector byte contains zeroes (00). Each ELAN configured on the PowerCell module uses the base address but has a unique value

in the Selector byte.

**LECS ATM Address** Indicates the ATM address of the LECS.

# 4.6 LANE 1.0 Configuration Examples

Depending upon the ATM hardware and software, these items can be configured on the ATM switch, on a workstation, or might be distributed between the ATM switch and a workstation. For example, the LECS may be installed on a Sun workstation and the LES and BUS on the FORE switch, as shown in Figure 4.6.

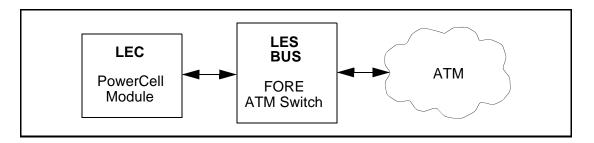


Figure 4.6 - Example of LECS Configuration on a Sun Workstation

Table lists the hardware used for each LANE 1.0 component.

Table 4.1 - LANE Component Hardware

LANE 1.0 Component	Hardware	Software
LEC	PowerCell module	ELAN names. Each ELAN is associated with an ATM segment. If no LECS is configured, the ATM address of the LES is specified with each ELAN name.
LES and BUS	ASX-200BX ATM Switch	ATM addresses of the LES and BUS. In this example, the LES and BUS are <i>colocated</i> (located on the same machine).
LECS	SBA-200 ATM Adapter Card (installed on Sun workstation)	LECS configuration file. Contains the ATM addresses of the ELANs. Also contains filters for accepting or discard- ing specific ATM addresses.

If a LECS is unavailable or cannot be added, ELANs can still be used if the LES address is supplied when adding the ELANs.

## 4.6.1 LEC Example (PowerCell 700)]

Before the segments can begin switching in the LANE 1.0 environment, an ELAN must be added to each segment, as shown in the following example. The terse form of the elan add command is used.

```
13:ASN-9000:atm/lane# elan add 1.9 elan1|0
14:ASN-9000:atm/lane# elan add 1.9 elan1|1
15:ASN-9000:atm/lane# elan add 1.9 elan1|1
16:ASN-9000:atm/lane# elan add 1.8 elan2 s
```

When adding ELANs to the segment using the elan add command, the ELAN is automatically enabled to get information from the LECS and the LEC software is started on the Power-Cell module.

# CHAPTER 5 FORE IP

This chapter describes the ASN-9000 support for the FORE IP ATM protocol. FORE IP is a FORE Systems ATM protocol that emulates basic characteristics of an IP network.



If setting up a new ATM network, FORE Systems recommends that LANE 1.0 be used to bridge and route between ATM and Ethernet. Configure FORE IP on the PowerCell module only if the ATM network already uses FORE IP. The ASN-9000 cannot form FORE IP connections to FORE Systems model ASX-100 or ASX-200 ATM switches. Connections can be formed *through* the switch, but not *to* the switch. FORE Systems model ASX-200BX and ASX-1000 do support AAL 5; therefore FORE IP connections can be made to these switches.

# 5.1 IP Characteristics Emulated by FORE IP

FORE IP emulates the following characteristics of the IP protocol:

- Address resolution using Address Resolution Protocol (ARP).
- · Dynamic connection establishment and teardown.
- Broadcast and multicast capability.

The FORE-IP implementation incorporates these services in software, using FORE System's Simple Protocol for ATM Network Signalling (SPANS) and a Connectionless Service (CLS).



The virtual interfaces created in FORE IP are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, not bridged, when destined for any other interfaces on the ASN-9000.

or

The FORE IP implementation works on the Network layer of the OSI model, and resolves IP addresses to ATM address. It does not use MAC addresses so there are none to use to bridge. Because of this, all traffic destined for other interfaces on the ASN-9000 must be routed.



Because SPANS addressing does not have a selector byte that can be assigned to multiple IP addresses to 1 segment, only assign FORE IP as the protocol for 1 segment of a given PowerCell.

## 5.2 The PowerCell Module and FORE IP

FORE IP networks contain the following components:

Simple Protocol for ATM Network Signalling (SPANS)

FORE System's proprietary signaling protocol for use in ATM local-area networks. SPANs signaling occurs over VPI/VCI 0,15.

Connectionless Service (CLS)

A service that provides transport of connectionless traffic (IP broadcasts, OSPF, RIP, ARP requests and ARP responses) through the ATM network. An ATM network contains only one CLS. Connectionless traffic, including FORE IP traffic, is forwarded to and from the CLS using the well-known VPI/VCI pair 0.14.



All FORE IP switched virtual circuits which are established using SPANs signaling are unidirectional. Each FORE IP connection requires an inbound VC and an outbound VC.

# 5.2.1 ARP Requests and Responses

ARP requests and responses are sent over the connectionless service, in conformance with RFC 826. The HARDWARE Type value in the ARP packet is set to 4040 (hex). The protocol type is set to 0800 (the Ethernet Type for IP packets). The hardware addresses for FORE in the ARP packets are the 8-byte SPANS ATM addresses.

### 5.2.2 IP Broadcasts

IP broadcast packets are dealt with in the same manner as ARP packets are—over the predefined VPI/VCI pair of 0,14. 0,14 is the VPI/VCI pair used for the CLS.

### 5.2.3 Point-to-Point IP Packets

Point-to-point IP packets are connection-oriented in nature, therefore virtual circuits between IP hosts or ATM switches must be established. FORE-IP provides dynamic connection establishment using SPANS. For an existing connection between two IP hosts, IP packets are forwarded out the appropriate virtual circuit using the correct AAL type. If a connection does not exist, SPANS establishes a new connection.

### 5.2.4 IP Multicast

Point-to-multipoint connections are used for supporting IP multicast traffic over an ATM network, such that IP multicast packets can be transmitted from one source to multiple destinations. These point-to-multipoint connections are created using SPANS group addresses. An end station must first be added to the point-to-multipoint connection for the particular IP multicast group before the end station can receive IP multicast packets. The end station joins the multicast group by opening a point-to-multipoint connection to the group. IP Multicasting is supported by hardware point-to-multipoint connections on FORE Systems products, therefore no special multicast processing is needed to service such multicast packets.

# 5.2.5 Configuring the ATM Switch for FORE IP

The PowerCell module supports FORE IP, the FORE Systems proprietary protocol that emulates IP on the ATM network. FORE IP uses SPANS 1.0, the FORE Systems proprietary signalling protocol, to dynamically establish and teardown VCs.



Disregard the procedures in this section if: SPANS 1.0 on the ATM switch ports has already been configured for AAL5. The FORE IP protocol is not being used.

(Segments can be reserved for FORE IP without actually enabling the protocol. If FORE IP segments are reserved in this way, the ATM switch must be configured before enabling FORE IP on the ASN-9000. If these steps are not performed, FORE IP does not operate when enabled on the reserved segments.)

In order for the ATM switch and the ASN-9000 to communicate using FORE IP, both devices must be using the same ATM Adaptation Layer (AAL). For SPANS, the PowerCell module uses AAL5. However, by default, FORE Systems ATM switches support AAL3/4.

For the PowerCell module to communicate with FORE Systems ATM switches using FORE IP, the SPANS AAL configuration on the port that directly connects the PowerCell module and the ATM switch must be changed to AAL5. For more information about SPANS AAL configuration, refer to the *ForeThought ATM Switch Users Manual*.

# 5.3 Configuring for FORE IP

To use the PowerCell module for routing in a FORE IP network, the following configuration tasks must be performed:

## 5.3.1 Configuring FORE IP on a PowerCell Segment

- Configure one or more IP interfaces on the FORE IP segment (if not already done so). For more information about adding an IP interface, see the *ForeRunner ASN-*9000 Software Reference Manual.)
- Set the ATM protocol type to FORE IP.
- Enable IP forwarding on a ASN-9000.
- Enable FORE IP on the PowerCell segments you configured for FORE IP.



The IP address you assigned to a FORE IP segment on the ASN-9000 can not be used on any other segment.

### 5.3.1.1 Enabling FORE IP on a PowerCell Segment

After configuring a PowerCell segment and an ATM switch to use FORE IP, yenable FORE IP on the segment. To enable FORE IP on a PowerCell segment, issue the following command:

senable/sdisable <seglist>

<seglist> Specifies the PowerCell segment on which FORE IP

is to be enabled.

The following is an example of the use of this command.

1:ASN-9000:atm/foreip# senable 1.4



Only one FORE IP segment can be configured on a PowerCell.

To disable FORE IP on a PowerCell segment, use the sdisable command. The following is an example of the use of this command:

5:ASN-9000:atm/foreip# sdisable

When FORE IP is disabled on the segment, the segment displays as disabled when the Power-Cell configuration is verified using the atm config show command. After FORE IP is disabled, it can be re-enabled, or another protocol can be assigned to the segment using the atm sset protocol command and configure the segment to use another protocol.

## 5.3.1.2 Displaying the Outbound Segment's Cache

The ASN-9000 FORE IP software maintains a cache of the outbound VCs for each PowerCell segment configured for FORE IP. The FORE IP cache maps the IP address of a switch or end station to its corresponding SPANS address. The IP addresses can be for local or remote switches or end stations reachable through the corresponding SPANS addresses. To display the FORE IP cache for a PowerCell segment, issue the following command:

cache [show] < seglist>

**seglist>** Specifies the PowerCell segment to display the FORE IP cache

5 - 5

The following example shows the information displayed by this command. In this example, the FORE IP cache for segment 1.7 is displayed.

The fields in this display show the following information:

Out VC

IP Address	Indicates the destination IP address of the switch or					
	the remote FORE IP workstation attached to the					
	PowerCell segment.					

Indicates the virtual channel identifier of the outbound VC. This VC is established by SPANS and is used by the PowerCell module to send FORE IP traffic from the PowerCell segment to the ATM switch or end station.

SPANS Address Indicates the destination SPANS address of the remote FORE IP workstation directly attached to the PowerCell segment.

In the following example, a single VC and SPANS address are associated with multiple IP addresses. This type of display is typical in configurations where multiple FORE IP end stations or ATM switches can be reached through the ATM switch attached to a PowerCell segment.

10:ASN-9000:atm/for	reip# <b>show</b>	cache 1.7
IP Address	Out VC	SPANS Address
134.163.20.3	121	00-00-00-01-f2-1a-23-bd
134.163.20.4	121	00-00-00-01-f2-1a-23-bd
134.163.20.5	121	00-00-00-01-f2-1a-23-bd
134.163.20.6	121	00-00-00-01-f2-1a-23-bd

In the example above, four different IP addresses can be reached through VC 121 and SPANS address 00-00-00-01-f2-1a-23-bd. The ATM switch associated with the SPANS address is locally attached. The IP addresses can be for the ATM switch or end station itself, or for other ATM switches or end stations that can be reached through the ATM switch associated with the SPANS address.

### 5.3.1.3 Displaying FORE IP Statistics

The ASN-9000 maintains FORE IP statistics for each PowerCell segment enabled for FORE IP. To display the FORE IP statistics for a PowerCell segment, issue the following command:

stats [show] <seglist>

**Specifies** the PowerCell segment for which you are displaying the FORE IP statistics.

The following example shows the information displayed by this command. In this example, the FORE IP cache for segment 1.7 is displayed.

```
10:ASN-9000:atm/foreip# stats show 1.7
FORE-IP packet statistics for segment 1.7
  Total Pkts sent:
                                394
  Total ARP Pkts sent to CLS:
  Total BMCAST Pkts sent to CLS: 0
  Total Unicast Pkts sent:
                                389
  Total Pkts received:
                                 426
                                5
  Total ARP Pkts received:
  Total BMCAST Pkts received:
  Total Unicast received:
                                 421
  Total Pkts dropped:
  Total Pkts not sent:
  Total Pkts forwarded to PE:
                                 389
  Total Pkts with bad length:
```

The fields in this display show the following information:

rieds in this display show the following information.		
Total Pkts sent	Indicates the total number of FORE IP packets sent on this PowerCell segment.	
Total ARP Pkts sent to CLS	Indicates the total number of FORE IP ARP packets sent by this PowerCell segment to the FORE IP CLS.	
Total BMCAST Pkts sent to CLS	Indicates the total number of FORE IP broadcast or multicast packets sent by this PowerCell segment to the FORE IP CLS.	
Total Unicast Pkts sent	Indicates the total number of FORE IP unicast packets sent by this PowerCell segment.	
Total Pkts received	Indicates the total number of FORE IP packets received on this PowerCell segment.	
Total ARP Pkts received	Indicates the total number of FORE IP ARP packets received on this PowerCell segment from the FORE IP CLS.	

Total BMCAST Pkts received Indicates the total number of FORE IP broadcast or

multicast packets received on this PowerCell

segment from the FORE IP CLS.

packets received on this PowerCell segment.

**Total Pkts dropped** Indicates the total number of packets dropped by

this PowerCell segment.

Total Pkts not sent Indicates the total number of packets that were not

sent by this PowerCell segment.

Total Pkts forwarded to PE Indicates the total number of FORE IP packets

forwarded to the Packet Engine by this PowerCell segment. After receiving the packets from the PowerCell module, the Packet Engine discards or

forwards the packets as needed.

Total Pkts with bad length 
Indicates the total number of FORE IP packets that

did not have the correct length.

### 5.3.1.4 Clearing FORE IP Statistics

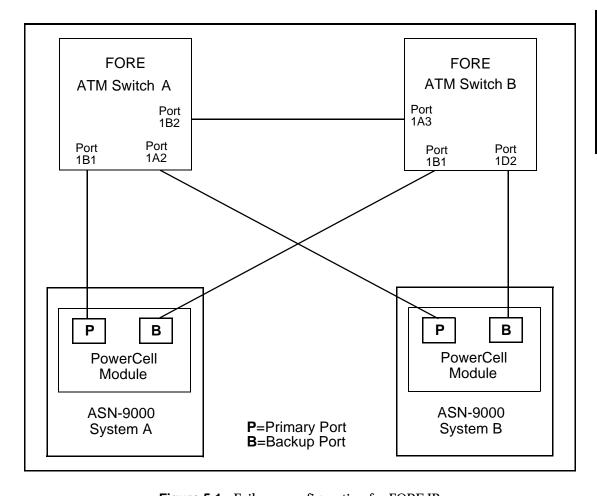
To clear FORE IP Statistics for a PowerCell segment, issue the following command:

stats clear <seqlist>

After clearing the FORE IP statistics, the PowerCell module begins accumulating new statistics.

## 5.3.2 Configuring Your FORE IP Network for Failover

A FORE IP network can be configured so that network connections are sustained if a failure occurs in one of the links between the PowerCell modules and ATM switches. To configure for failover, at least two PowerCell systems containing PowerCell modules and at least two ATM switches are required. Figure 5.1 shows an example of a FORE IP failover configuration.



**Figure 5.1 -** Failover configuration for FORE IP.

To set up the configuration shown in Figure 5.1:

- 1. Connect the ASN-9000 modules to the ATM switches as shown in Figure 5.1.
- 2. If it has not already been done so, configure the FORE IP ports on the ATM switches to use interface asx0.
- 3. If it has not already been done so, enable FORE IP on the PowerCell segments being used for the FORE IP connections with the ASX switches.



It is not important which ports on the ATM switches the Fiber or UTP cables are plugged into, as long as the primary and backup ports on the PowerCell are connected to the correct switches as shown in Figure 5.1.

# CHAPTER 6

# Classical IP over ATM

This chapter describes the ASN-9000 support for CLIP (Classical IP over ATM). CLIP is an ATM Forum standard that IP datagrams and Address Resolution Protocol (ARP) requests and replies to be transmitted over ATM using ATM Adaptation Layer 5 (AAL5). CLIP is described in RFC 1577.

## 6.1 The PowerCell Module and CLIP

CLIP networks contain the following components:

Logical IP Subnet (LIS)

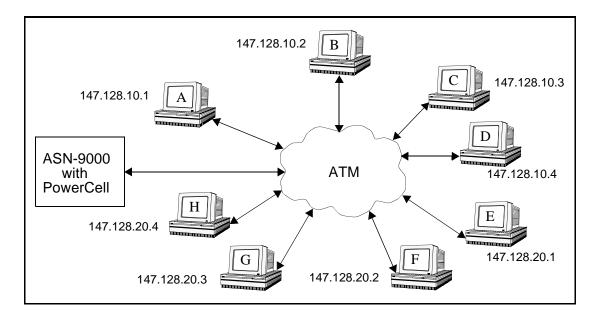
A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. One LIS can be configured on each PowerCell segment using CLIP. After the CLIP network is initialized, individual members of the LIS are joined directly to other members by VCs. Hosts that are not members of the LIS can be reached by using a LAN router, such as the ASN-9000.

ATM ARP server

A device that can translate IP addresses into ATM addresses. When the ATM ARP server receives an ARP request from a host in an LIS, the ATM ARP server looks up the IP address supplied in the ARP request and returns the ATM address.

The virtual interfaces that are created in CLIP are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, not bridged, when destined for any other interfaces on the ASN-9000, including another LIS on the same PowerCell module.

Figure 6.1 shows an example of an ATM network using CLIP. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x and 147.128.20.x. The subnet mask used in the following example is 255.255.255.0.



**Figure 6.1 -** CLIP network.

Figure 6.2 shows the same network from the ASN-9000 system's perspective. Each LIS is associated with its own PowerCell segment.

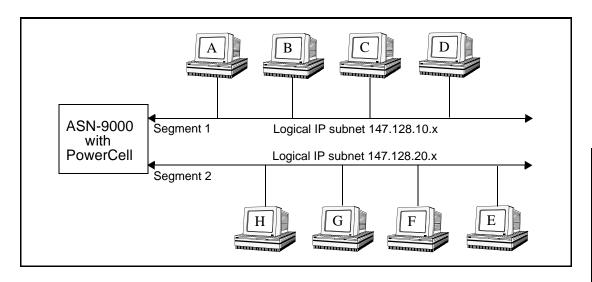


Figure 6.2 - ASN-9000 CLIP Network Containing LISs

Figure 6.1 and Figure 6.2 show two LISs connected to a PowerCell module, which is installed in an ASN-9000. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell module enables the LISs to communicate by routing IP traffic between the LISs.

## 6.1.1 SVC Support and Packet Encapsulation

The PowerCell module establishes connections between members of an LIS using SVCs. To establish an SVC, the PowerCell software uses Q.2931 signalling, as specified in the ATM Forum's User-Network Interface (UNI) 3.0 Specification.

After the PowerCell establishes an SVC, the software encapsulates IP packets using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5 (ATM Adaptation Layer 5).

The default Maximum Transmission Unit (MTU) is 9,180 bytes. (When the SNAP header is added, the size becomes 9,188 bytes.). The maximum IP datagram is 9180.

## 6.1.2 ATM ARP Support

CLIP uses ATM Address Resolution Protocol (ATM ARP) and Inverse ATM ARP for address resolution within an LIS. ATM ARP is based on RFC 826 and Inverse ATM ARP is based on RFC 1293.

To configure a PowerCell segment to use an ATM ARP server in an LIS, specify the ATM Address of the ATM ARP server when configuring the PowerCell segment for CLIP. (This and other tasks are performed using the clip sset command. See Section 6.2.2.)

Each LIS must have one ATM ARP server. The same ATM ARP server can be shared across multiple LISs, but an LIS cannot contain two operational ARP servers. The ATM ARP server must have authoritative responsibility for resolving ATM ARP Requests from all IP nodes within the LIS.

When the ATM ARP server is configured, an IP address for each LIS the server supports must be configured.

When an IP node is configured for CLIP, the ATM address of the ATM ARP server in the LIS to which the node belongs is specified. For example, when a PowerCell segment is configured for CLIP, one of the configuration tasks is to specify the ATM address of the ATM ARP server.

### 6.1.2.1 ATM ARP Table Aging

ATM ARP entries in the ATM ARP table on the ATM ARP server are valid for a minimum of 20 minutes. The aging interval for ATM ARP entries are configured on the ATM ARP server itself. Refer to the documentation for the ATM ARP server for information.

After the aging interval on the server expires, the server generates an Inverse ARP Request on the open VC (if any) associated with the ARP entry.

- If the server receives an Inverse ARP Reply on a VC, the entry is updated and the aging timer starts over for the entry.
- If the server does not receive at least one Inverse ARP Reply, the server removes the entry from its ATM ARP table.

## 6.1.3 MTU Size

The default MTU size for IP members operating over the ATM network is 9180 bytes. The LLC/SNAP header is 8 bytes, therefore the default ATM AAL5 protocol data unit size is 9188 bytes. In Classical IP subnets, values other than the default can be used if, and only if, all members in the LIS have been configured to use the non-default value.

If a Classical IP packet is locally forwarded by the PowerCell module from one LIS to another LIS attached to the module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the ASN-9000), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long.

# 6.2 Configuring a PowerCell Segment for Classical IP

To use a PowerCell segment for Classical IP routing in an ATM network, the following configuration tasks must be performed for each segment:

- Configure an IP interface on the segment (if not already done). (Use the ip interface add command.
- Set the ATM protocol type to CLIP. (Use the sset protocol command.
- Specify the ATM address of the ATM ARP server attached to the segment and enable Classical IP on the segment. (Use the clip sset command.)

The following sections describe how to perform these tasks.

# 6.2.1 Configuration Considerations

Before configuring the PowerCell module for CLIP, make sure the configuration plans are not affected by the following considerations:

Only one IP interface on a PowerCell segment enabled for Classical IP.



IP routes must be statically configured on a PowerCell segment enabled for Classical IP.

- Broadcast traffic, such as RIP or OSPF, is not supported, as there is no mechanism
  in place to distribute broadcast packets. If the segments being configured require
  the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.
- Only one IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 VLANs are not supported on PowerCell segments configured for CLIP.
   To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 or 1483 LANE Frame PVCs on the segments.
- Do not include the segments that configured for CLIP in ASN-9000 bridge (network) groups.

## 6.2.2 Configuring a Segment for Classical IP on ATM

Before enabling CLIP on a segment, the PowerCell segment must be configured to use PVC Bridging using the atm sset protocol command. To configure the PowerCell segment to use CLIP, telnet into or connect to the ASN-9000 through the TTY interface, change to the atm subsystem, and configure the desired segment. After configuring a PowerCell segment to use CLIP:

- Specify the ATM address of the ATM ARP server. (This must be done before enabling Classical IP on the segment.)
- Enable Classical IP on the segment.

To perform these tasks, use the atmarp sset command. The syntax for this commandis:

```
atmarp-addr | as sset <arpsvr-atm-addr> <seglist>
```

**<arpsvr-atm-addr>** Specifies the ATM address of the ATM ARP server.

Specify the address in Network Service Address

Point (NSAP) format.

<seglist> Specifies the PowerCell segment being configured

for Classical IP.

Following are some examples of the atmarp sset command. The first command in this example specifies the ATM address of the ARP server on the LIS. The second command enables Classical IP on segment 2.2. In both cases, the terse form of the senable command is used.

```
10:ASN-9000:atm/clip# as sset 45.0005.80.ffe100.0000.f215.1490.00-00-ef-01-ab-cd.04 2.2 Okay
```

```
11:ASN-9000:atm/clip# senable segment Enable CLIP segment
```

### 6.2.2.1 Configuring ARP-Aging on the ATM ARP Server

To set ARP-aging on the ARP server, use the arp-aging sset command. The syntax for this command is:

```
arp-aging|aa sset <seconds> <seglist>
```

<seconds>

Specifies the maximum time that an ATM ARP entry is kept without being used. The minimum value that can be set is 10 seconds and the maximum is 600 seconds. The default is 300 seconds.

**seglist>** Specifies the segment being configured for ARPaging.

Following is an example of the arp-aging sset command.

10:ASN-9000:atm# **aa sset 500 1.4** Okay

### 6.2.2.2 Configuring ARP-Aging Timeout

To set ARP-aging timeout on the ARP server, use the arp-conn-timeout sset command. The syntax for this command is:

arp-conn-timeout|at sset <seconds> <seglist>

<seconds>

Specifies the time to wait when connecting to an ARP server to detect if the attempt failed. The ASN-9000 automatically tries to reconnect if the attempt failed. The minimum value that can be set is 5 seconds and the maximum is 60 seconds. The default is 10 seconds.

\_

<seglist>

Specifies the segment being configured for ARPaging timeout.

Following is an example of the arp-conn-timeout sset command.

10:ASN-9000:atm# **at sset 35 1.4** Okay

# 6.2.3 Displaying the Classical IP Configuration

To verify the Classical IP configuration of a PowerCell segment, issue the following command:

config [show] [local|1] <seglist>|all

[local|I] Specifies the locally stored information on the packet

engine.

Classical IP configuration. Specify a single segment, a comma-separated list of segments, or a hyphen-separated range of segments. If all is specified, configuration information is displayed for all the PowerCell segments in the chassis that are

configured for Classical IP.

### Following is an example of this command.

10:ASN-9000:atm/clip# config show 2.2 Show remote config for segment 2.2

Displaying information from the ATM card for segment22

Classical-IP-over-ATM Configuration segment 22

IP address: 111.22.33.4

Interface ATM Address: 47.0005.80.ffe100.0000.f215.1490.00-00-ef-01-cd-ba.06 ATM ARP Svr Addr: 45.0005.80.ffe100.0000.f215.1490.00-00-ef-01-ab-cd.04 Admin Status: Enabled

Physical State: Up
Oper. State: Running (SVC Mode)
IP/IF Stats: IP/IF configured
Arp Age (secs): 1200000

Arp conn timout (secs) 1200000

#### The fields in this display show the following information:

Displays the ATM address of the ATM ARP server ATM ARP Svr Addr

for the LIS.

#### **Displaying Classical IP Statistics** 6.2.4

To display Classical IP statistics for a PowerCell segment, issue the following command:

stats [show] <seglist>|all

<seglist>|all

Specifies the PowerCell segment(s) to display Classical IP statistics. Specify a single segment, a comma-separated list of segments, or a hyphenseparated range of segments. If all is specified, statistics are displayed for all the PowerCell segments in the chassis that are configured for Classical IP.

### Following is an example of this command.

10:ASN-9000:atm# stats show 2.2

Classical IP Statistics for Interface 147.128.10.1 on segment 2.2

-----

In UCast Pkts: 347789 In Mcast Pkts: 233 4172 Out UCast Pkts: 499 Out Mcast Pkts: In Errors: In Discard: 23 Out Pkts Dropped: 311 Out ARP Req: 45 In ARP Req: In InARP Req: 2 In ARP Rep: 41 Out ARP Rep: 3 ARP Age Cnt: 48

### The fields in this display show the following information:

the PowerCell segment(s).

In Mcast Pkts Indicates the number of multicast packets received

on the PowerCell segment(s).

Out UCast Pkts Indicates the number of unicast packets sent on the

PowerCell segment(s).

Out Mcast Pkts Indicates the number of multicast packets sent on the

PowerCell segment(s).

In Errors 
Indicates the number of packets containing errors

received on the segment(s).

segment(s) that were discarded by the PowerCell

module.

dropped by the PowerCell module, rather than sent.

Out ARP Req Indicates the number of ARP requests sent to the LIS

ARP server on the segment.

In ARP Req Indicates the number of ARP requests received from

the LIS on the segment.

In InARP Req Indicates the number of Inverse ARP requests

received from the LIS ARP server on the segment.

In ARP Rep Indicates the number of ARP replies received from

the LIS on the segment.

Out ARP Rep Indicates the number of ARP replies sent on the

segment.

ARP Age Cnt Indicates the number of ARP entries that the

PowerCell software has aged out of the VC and ARP

table.

### 6.2.4.1 Clearing Classical IP Statistics

To clear Classical IP statistics for a PowerCell segment, issue the following command:

stats clear <seglist> all

**<seglist>|all** Specifies the PowerCell segment(s) to clear Classical

IP statistics. Specify a single segment, a commaseparated list of segments, or a hyphen-separated range of segments. If all is specified, statistics are cleared for all the PowerCell segments in the chassis

that are configured for Classical IP.

## 6.2.5 Removing a Classical IP Segment

To remove CLIP from a segment, disable the segment using the sdisable command and then remove the protocol from the segment using the atm sset protocol command. The sdisable command is described in Section 6.2.2.

Following are some examples of the commands used to disable a CLIP segment. The first command disables the segment and removes it from use, and the second removes the CLIP protocol from the segment. In this example, the terse form of the sdisable and atm sset protocol commands are used. Note that when a segment is disabled, it is not necessary to specify the ARP server on the LIS.

12:ASN-9000:atm/clip# sdisable 2.2

13:ASN-9000:atm# sset 2.2 s n

#### 6.2.5.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network.
   Members outside of the LIS can be accessed only by a router such as the ASN-9000.
- All members of the LIS must have a mechanism for resolving IP addresses into ATM addresses using ATM ARP. Members attached by SVCs must be able to resolve IP addresses into ATM addresses using Inverse ATM ARP.
- All members of the LIS must have a mechanism for resolving VCs into IP addresses using Inverse ATM ARP over PVCs.
- All members within the LIS must be able to communicate through ATM with all
  other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

### 6.2.5.2 ATM Parameters for Classical IP

The following list identifies a set of ATM specific parameters that must be implemented on each IP node connected to the ATM network:

- The ATM address of the node. The address is resolved automatically by ILMI.
- The ATM address of the ATM ARP server in the LIS to which the node belongs. In an SVC environment (such as the one including the PowerCell module), ATM ARP requests are sent to this address for the resolution of target protocol addresses to target ATM addresses. The ATM ARP server must have authoritative responsibility for resolving the ATM ARP requests of all the IP nodes in the LIS.

## Classical IP over ATM

# CHAPTER 7

# Classical IP PVC over ATM

This chapter describes the ASN-9000 support for CLIP PVC over ATM. Classical IP over ATM (CLIP) is an ATM Forum standard (RFC 1577) that allows the transmission of IP datagrams and Address Resolution Protocol (ARP) requests and replies over ATM using ATM Adaptation Layer 5 (AAL5).

Normally, ATM connections in a Classical IP environment are established dynamically using UNI 3.0. ARP, ILMI and UNI 3.0 all work together as when setting up an SVC. If a host or switch in an LIS does not support UNI 3.0, however, it is not possible to establish an SVC. In this case, a Classical IP PVC can be used for communication.

On each of the CLIP PVC ASN-9000 segments, the **sset** command is used to establish the PVC. An unused VCI must be chosen for each CLIP PVC ASN-9000 segment. PVCs using the chosen VCI must also be setup from each of the hosts to their connecting switch, and then on all of the switches between the two connecting switches.



Both the incoming and outgoing connections are set up simultaneously on the host, but they must be set up individually on the switches. The same VCI is used by a host to send on the PVC as well as receive on the PVC. The IP datagrams are sent over the PVC using AAL5 with LLC/SNAP encapsulation.

## 7.1 The PowerCell Module and CLIP

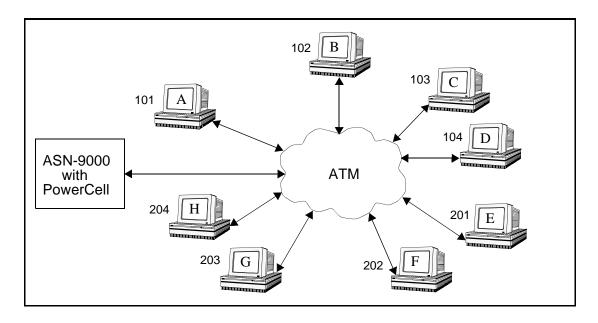
CLIP networks contain the following components:

Logical IP Subnet (LIS)

A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. One LIS can be configured on each PowerCell segment used for CLIP. Individual members of the LIS are joined directly to other members using configured Permanent Virtual Circuits (PVCs). Hosts that are not members of the LIS can be reached only by using a LAN router, such as the ASN-9000.

Virtual interfaces that are created in CLIP PVC are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, when destined for any other interfaces on the ASN-9000, including another LIS on the same PowerCell module.

Figure 7.1 shows an example of an ATM network using CLIP PVC. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x with PVCs 100-104 on segment 1 and 147.128.20.x with PVCs 201-205 on segment 2. The subnet mask used in the following example is 255.255.255.0.



**Figure 7.1 -** CLIP PVC network.

Figure 7.2 shows the same network from the ASN-9000 perspective. Each LIS is associated with its own PowerCell segment.

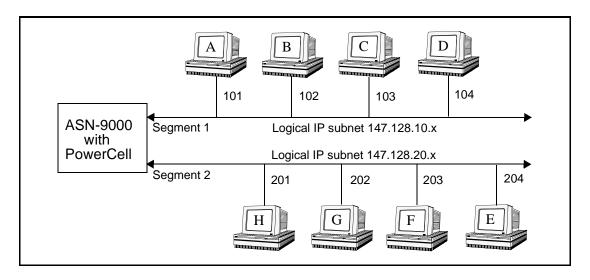


Figure 7.2 - ASN-9000 CLIP PVC Network Containing LISs

Figure 7.1 and Figure 7.2 show two LISs connected to a PowerCell module, which is installed in a ASN-9000. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell module enables the LISs to communicate by routing IP traffic between the LISs. From the ASN-9000 in Figure 7.2, segment 1 connects with PVC 101, with a logical IP subnet 147.128.10x, to station A, 102 to station B, and so on. Segment 2 connects with PVC 201, with a logical IP subnet 147.128.20x, to station H, 202 to station G, and so on.

## 7.1.1 PVC Support and Packet Encapsulation

The PowerCell module can establish connections between members of an LIS using PVCs. After the PowerCell software establishes a PVC, the software encapsulates IP packets using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5.

The default MTU is 9,180 bytes. (When the SNAP header is added, the size becomes 9,188 bytes.). The maximum packet size is 9180. The same (MTU) size is used for all VCs in a LIS.

# 7.1.2 ATM ARP Support

CLIP PVC uses Inverse ATM ARP to resolve the IP addresses of the host at the other end of a VC. Inverse ATM ARP is based on RFC 1293. To configure a PowerCell segment to use CLIP PVC the VC is specified. (This task is p[erformed using the clippvc sset command. See Section 7.2.2.)

When configuring a PowerCell segment to support CLIP PVC, the segment must be IP configured. Routing must be enabled.

#### 7.1.2.1 ATM ARP Table Aging

When the requesting station receives the Inverse ARP reply, it may complete the ATM ARP table entry and use the provided address information. It is the responsibility of each IP station supporting PVCs to revalidate ATM ARP table entries as part of the aging process. The ASN-9000 responds in ARP. A host revalidates a PVC every 15 minutes by sending InARP request over the PVC. If an InARP reply is not received, the revalidation fails, the PVC is marked invalid (as shown through the config command), and communication over the PVC is no longer possible.

Once a PVC is marked invalid, an attempt is made to validate the PVC before transmitting. Transmission proceeds only when validation succeeds.

Client ATM ARP table entries are valid for a maximum of 15 minutes.

- If the PowerCell receives an Inverse ATM ARP Reply on a VC, the entry is updated and the aging timer starts over for the entry.
- If the PowerCell does not receive an Inverse ATM ARP Reply, the entry is marked invalid in the ARP cache.

#### 7.1.2.2 CLIP PVC ARP Display

Upon enabling a configured CLIP PVC segment on a ASN-9000, an Inverse ATM ARP request is sent out on the PVC. When a response is received from the peer member or station, the entry is put into the ATM ARP table of the PowerCell. The entries that are learned through the Inverse ATM ARP can be displayed using the arp show command. The following is the syntax for this command:

**<seglist>|all** Displays the cache entries established through CLIP PVC on the specified segment.

The following are the results produced by this command. Displayed is an Inverse ATM ARP request sent on ASN-9000 segment 1.1 over PVC.

IP Address

Indicates the IP address of the peer member of the LIS that has responded to the Inverse ATM ARP request.

**PVC** Indicates the configured PVC.

State

**Segment** Displays the segment configured for CLIP PVC.

Displays the state of the entry that responded to the Inverse ATM ARP request. This field is valid when the responding member for the Inverse ATM ARP request is a member of the LIS as the ASN-9000 segment configured for CLIP PVC.

The state is invalid if the peer LIS member does not respond to the Inverse ATM ARP request after the timeout period or if the member responding is not a member of the LIS.

The following example shows PowerCell segment 5.2 configured for CLIP PVC with an IP address of 100.1.1.2. The peer LIS member, with an IP address of 100.1.1.3 has responded to the Inverse ATM ARP request through an Inverse ATM ARP reply. The state of the PVC is "VALID".

117:ASN-9000:atm/clippvc# arp show all

Configured PVCs and state:

IP Address	PVC	Segment	State
100.1.1.3	200	5.2	VALID

When a PowerCell segment is configured for CLIP PVC and if a non-member of the LIS responds to his inverse ATM ARP request the state will be "INVALID".

In the following example, segment 5.3 is configured with an IP address of 200.1.1.2. A non-LIS member with an IP address of 200.1.2.3 has responded to an Inverse ATM ARP request through an Inverse ATM ARP reply.

117:ASN-9000:atm/clippvc# arp show all

Configured PVCs and state:

IP Address	PVC	Segment	State
200.1.2.3	500	5.3	INVALID

When a PowerCell segment is configured for CLIP PVC, and if a peer LIS member stops responding to an Inverse ATM ARP request after the revalidation interval is reached, the state is set to "INVALID".

In the following example, segment 5.2 is configured with an IP address of 100.1.1.2. The peer member with an IP address of 100.1.1.3 has stopped responding to the Inverse ATM ARP request, thus set to "INVALID".

117:ASN-9000:atm/clippvc# arp show all
Configured PVCs and state:

IP Address PVC Segment State
-----100.1.2.3 200 5.2 INVALID

#### **7.1.3 MTU Size**

If a Classical IP packet is locally forwarded by the PowerCell module from one LIS to another LIS attached to the same module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the ASN-9000), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long.

# 7.2 Configuring a PowerCell Segment for CLIP PVC

To use a PowerCell segment for CLIP PVC routing in an ATM network, perform the following configuration tasks for each segment:

- Configure an IP interface on the segment (if not already done). (Use the ip interface add command.
- Set the ATM protocol type to Classical-IP-PVC. (Use the atm sset protocol command.
- Enable IP routing.
- Specify the PVC and the revalidation interval period (If nothing is specified for the revalidation period, the default of 15 minutes is used).)

The following sections describe how to perform these tasks.

## 7.2.1 Configuration Considerations

Before configuring the PowerCell module for CLIP PVC, make sure configuration plans are not affected by the following considerations:

- Only one IP interface can be configured on a PowerCell segment enabled for CLIP PVC.
- Broadcast traffic is not supported, as there is no mechanism in place to distribute broadcast packets. If the segments being configured require the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.
- Only one IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 VLANs are not supported on PowerCell segments configured for CLIP PVC. To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 on the segments.
- Do not include the segments that configured for CLIP PVC in ASN-9000 bridge (network) groups.

## 7.2.2 Configuring a Segment for CLIP PVC on ATM

Before enabling CLIP PVC on a segment, configure the PowerCell virtual segment to use CLIP PVC using the atm sset protocol command. To configure the PowerCell segment to use CLIP PVC, telnet into or connect to the ASN-9000 through the TTY interface, change to the atm subsystem, and configure the desired segment using the following command:

sset proto[col] cproto> <seglist>|all

oto>

Specifies the protocol to be used on a segment. To configure the PowerCell segment to use CLIP PVC issue the following:

cp[classical-ip-pvc] Classical IP PVC over ATM (see RFC 1577).

<segment-list>|all

Specifies the PowerCell segment being configured for CLIP PVC. Specify a single segment, a commaseparated list of segments, or a hyphen-separated range of segments. If all is specified, all the segments on all the PowerCell modules in the chassis are configured to use the CLIP PVC protocol.

After configuring a PowerCell segment to use CLIP PVC:

- Specify the PVC to be used on the segment. (Do this before you enabling CLIP PVC on the segment.)
- Enable CLIP PVC on the segment.

To perform these tasks, use the sset pvc and senable commands. The syntax for this command is:

sset <pvc> <seglist> [<revalidation time>]

<pvc> Specifies the PVC to be used on the segment. Valid

PVCs range between 32 and 1023.

<seglist> Specifies the PowerCell segment being configured

for CLIP PVC.

<revalidation time> Specifies the revalidation interval after sending an

Inverse ATM ARP to validate the LIS member using this PVC. The Inverse ARP reply, received by the PVC configured PowerCell segment, discovers and

keeps the IP address of the LIS member.

Following are some examples of the sset pvc and senable commands. The first command in this example sets the PVC on segment 5.2 and a revalidation time of 20 minutes. The second command ignores the revalidation interval by defaulting to 15 minutes. The third command enables the configured CLIP PVC segment.

```
10:ASN-9000:atm/clippvc# sset 300 5.2 20 Okay
11:ASN-9000:atm/clippvc# sset 200 5.2 Okay
12:ASN-9000:atm/clippvc# senable 5.2 Segment 5.2 enabled Okay
```

## 7.2.3 Removing CLIP PVC from a Segment

To remove CLIP PVC from a segment, perform the following steps:

- 1. Disable the segment using the sdisable command (The sdisable command is described in Section 7.2.2).
- Remove all configured PVCs from a segment, using the pdelete command. The pdelete command is used to delete a single PVCs or all of the PVCs from a CLIP PVC segment.

3. Undefine the protocol using the atm proto sset None command.

The following example shows how to perform these steps:

```
10:ASN-9000:atm/clippvc# sdisable all
Okay
11:ASN-9000:atm/clippvc# pdelete all
Okay
11:ASN-9000:atm# proto sset None all
Okay
```

#### 7.2.3.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS (Logical IP Subnet) configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network.
   Members outside of the LIS can be accessed only by a router, such as the ASN-9000.
- All members of the LIS must have a mechanism for resolving IP addresses into ATM addresses using ATM ARP.
- All members of the LIS must have a mechanism for resolving VCs into IP addresses using Inverse ATM ARP over PVCs.
- All members within the LIS must be able to communicate through ATM with all
  other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

#### 7.2.3.2 ATM Parameters for Classical IP

The following list identifies a set of ATM specific parameters that must be implemented on each IP node connected to the ATM network:

- The ATM address of the node. The address is resolved automatically using ILMI.
- The PVC that is used to communicate to a peer member of the LIS. Inverse ATM ARP resolves the IP address of the peer member of the LIS.
- The revalidation interval used after the sent Inverse ARP requests update the peer LIS member's active or inactive state.

# 7.3 Displaying the CLIP PVC Configuration

The current CLIP PVC configuration can be displayed by using the config [show] command. Following is an example of the display produced by this command:

117:ASN-9000:atm/clippvc# config show all Configured PVCs and state:

PVC State Segment Reval Time
--- ----- ------300 enl 1.1 15

**PVC** Specifies the PVC associated with the segment.

State Indicates whether CLIP PVC is enabled or disabled

on this segment.

**Segment** Shows the segment running CLIP PVC.

**Reval Time** Specifies the revalidation interval period (If nothing

is specified for the rvalidation period, the default is

15 minutes).

### 7.3.1 Displaying and Clearing Statistics

The current CLIP PVC statistics can be displayed by using the **stats** [show] command. Following is an example of the display produced by this command:

117:ASN-9000:atm/clippvc# stats show 1.1 Displaying statistics from the ATM Card for segment 1.1 Classical-PVC-Over-ATM Statistics for segment 1.1 \_\_\_\_\_ Connection Fails: Total Control Packets In: 0 Total Control Packets Out: 0 Arp Replies In: Arp Replies Out: Total Arp Replies : Arp Requests In: 0 Arp Requests Out: Deleted Arp Replies: 0 Unknown Arp Replies: 0 Total InARP Requests: 0 Total ARP NAKs: Total bad ARP operations: 0 Total times CLIP restarted: Unknown Packets received: 17554 Unicast Data in: Bad ip packets in: Unicast Packets dropped: 1
Unicast packets forwarded: 17553

The stats clear command is used to clear CLIP PVC over ATM statistics. All learned entries are removed, but static entries (created using the sset atmarp command) remain in the table. These must be removed manually using the pdelete command.

This command can be used to help restabilize the network after a host is moved from one segment to another. When there is activity on the network, the cleared entries quickly reappear in the ATM ARP table, and a host that has been moved will be relearned on its new segment.

A Classical IP PVC is removed on the host side using pdelete command after disabling the PVC segment using the sdisable command. Both incoming and outgoing connections are removed simultaneously. The PVC must then be removed from each of the network switches involved.

#### Classical IP PVC over ATM

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